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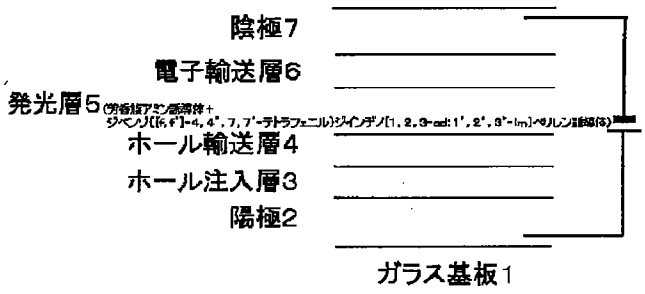
(71)出願人　000004237
日本電気株式会社
東京都港区芝五丁目７番１号
(72)発明者　元松　俊彦
東京都港区芝五丁目７番１号　日本電気株式会社内
(72)発明者　坂口　嘉一
東京都港区芝五丁目７番１号　日本電気株式会社内
(74)代理人　100096231
弁理士　稲垣　清

Ｆターム(参考)　3K007 AB00 AB02 AB03 AB04 CA01
CB01 DA00 DB03 EB00 FA01

(54)【発明の名称】　有機ＥＬ素子及び有機ＥＬディスプレイ

(57)【要約】
【課題】　従来に比べて、発光効率に優れ、輝度、色度の良好な赤色有機ＥＬ素子を提供する。
【解決手段】　発光層５において、特定の芳香族アミン誘導体と、赤色発光材料である特定のジベンゾ｛［ｆ，ｆ’］－４，４’，７，７’－テトラフェニル｝ジインデノ［１，２，３－ｃｄ：１’，２’，３’－ｌｍ］ペリレン誘導体とを混合して用いる。

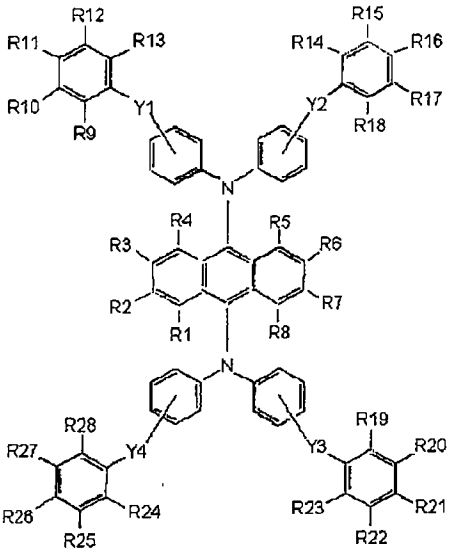


【特許請求の範囲】

【請求項１】　互いに対向する陽極と陰極間に、少なくとも単層又は複数層の有機薄膜よりなる発光層を備えた有機ＥＬ素子において、下記一般式［１］

【化１】

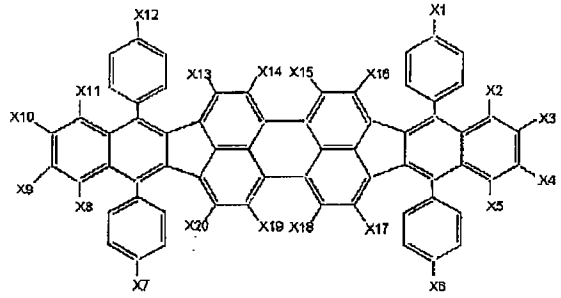
一般式［１］



［一般式［１］中のＲ1～Ｒ28は、それぞれ独立に水素原子、ハロゲン原子、置換若しくは未置換のアルキル基、置換若しくは未置換のアルコキシ基、置換若しくは未置換のアリール基、又は、置換若しくは未置換のアミノ基を表す。Ｙ1～Ｙ4は、それぞれ独立にＯ、Ｓ、SO_2、Ｃ＝Ｏ、CH_2O、CH_2OCH_2、又は、置換若しくは未置換のアルキレン基を表す。Ｒ1～Ｒ4、Ｒ5～Ｒ8は、互いに結合して飽和若しくは不飽和の５員環又は６員環を形成してもよい。］で示される芳香族アミン誘導体と、下記一般式［２］

【化２】

一般式［２］

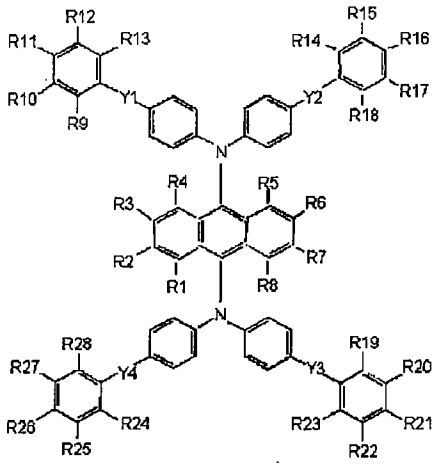


［一般式［２］中のＸ1～Ｘ20は、それぞれ独立に水素原子、ハロゲン原子、置換若しくは未置換のアルキル基、置換若しくは未置換のアルコキシ基、置換若しくは未置換のアリール基、又は、置換若しくは未置換のアミノ基を表す。Ｘ1～Ｘ20は、互いに結合して飽和若しくは不飽和の５員環又は６員環を形成してもよい。］で示されるジベンゾ｛［ｆ，ｆ’］－４，４’，７，７’－テトラフェニル｝ジインデノ［１，２，３－ｃｄ：１’，２’，３’－ｌｍ］ペリレン誘導体とを混合させた少なくとも１層の発光層を有していることを特徴とする有機ＥＬ素子。

【請求項２】　互いに対向する陽極と陰極間に、少なくとも単層又は複数層の有機薄膜よりなる発光層を備えた有機ＥＬ素子において、下記一般式［４］

【化３】

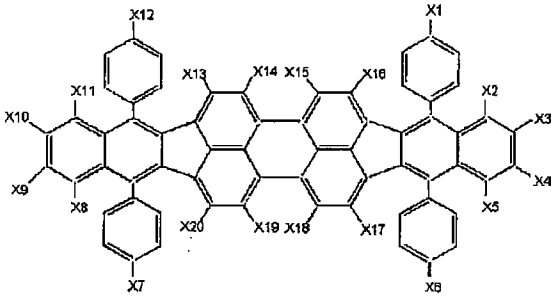
一般式［４］



［一般式［４］中のＲ1～Ｒ28は、それぞれ独立に水素原子、ハロゲン原子、置換若しくは未置換のアルキル基、置換若しくは未置換のアルコキシ基、置換若しくは未置換のアリール基、又は、置換若しくは未置換のアミノ基を表す。Ｙ1～Ｙ4は、それぞれ独立にＯ、Ｓ、SO_2、Ｃ＝Ｏ、CH_2O、CH_2OCH_2、又は、置換若しくは未置換のアルキレン基を表す。Ｒ1～Ｒ4、Ｒ5～Ｒ8は、互いに結合して飽和若しくは不飽和の５員環又は６員環を形成してもよい。］で示される芳香族アミン誘導体と、下記一般式［２］

【化４】

一般式［２］



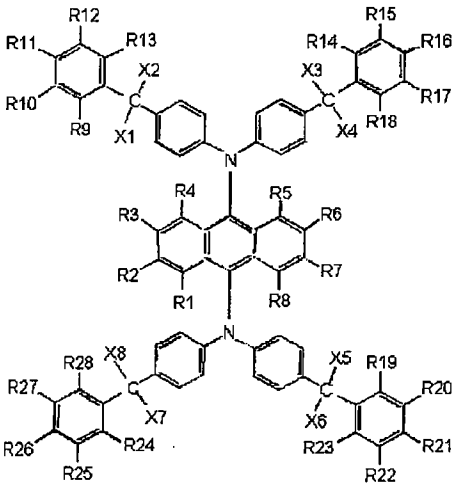
［一般式［２］中のＸ1～Ｘ20は、それぞれ独立に水素原子、ハロゲン原子、置換若しくは未置換のアルキル基、置換若しくは未置換のアルコキシ基、置換若しくは未置換のアリール基、又は、置換若しくは未置換のアミノ基を表す。Ｘ1～Ｘ20は、互いに結合して飽和若しくは不飽和の５員環又は６員環を形成してもよい。］で示されるジベンゾ｛［ｆ，ｆ’］－４，４’，７，７’－テトラフェニル｝ジインデノ［１，２，３－ｃｄ：１’，２’，３’－ｌｍ］ペリレン誘導体とを混合させ

る有機ＥＬ素子。

【請求項３】　互いに対向する陽極と陰極間に、少なくとも単層又は複数層の有機薄膜よりなる発光層を備えた有機ＥＬ素子において、下記一般式［５］

【化５】

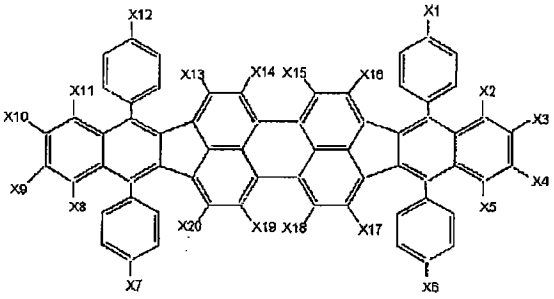
一般式［５］



［一般式［５］中のＲ１～Ｒ２８は、それぞれ独立に水素原子、ハロゲン原子、置換若しくは未置換のアルキル基、置換若しくは未置換のアルコキシ基、置換若しくは未置換のアリール基、又は、置換若しくは未置換のアミノ基を表す。Ｘ１～Ｘ８は、置換若しくは未置換の炭素数１～２０のアルキル基、又は、置換若しくは未置換の炭素数６～１６のアリール基を表す。Ｒ１～Ｒ４、Ｒ５～Ｒ８は、互いに結合して飽和若しくは不飽和の５員環又は６員環を形成してもよい。］で示される芳香族アミン誘導体と、下記一般式［２］

【化６】

一般式［２］

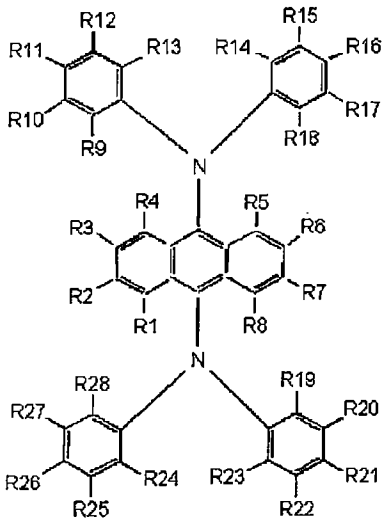


［一般式［２］中のＸ１～Ｘ２０は、それぞれ独立に水素原子、ハロゲン原子、置換若しくは未置換のアルキル基、置換若しくは未置換のアルコキシ基、置換若しくは未置換のアリール基、又は、置換若しくは未置換のアミノ基を表す。Ｘ１～Ｘ２０は、互いに結合して飽和若しくは不飽和の５員環又は６員環を形成してもよい。］で示されるジベンゾ｛［ｆ，ｆ’］－４，４’，７，７’－テトラフェニル｝ジインデノ［１，２，３－ｃｄ：１’，２’，３’－ｌｍ］ペリレン誘導体とを混合させた少なくとも１層の発光層を有していることを特徴とする有機ＥＬ素子。

【請求項４】　互いに対向する陽極と陰極間に、少なくとも単層又は複数層の有機薄膜よりなる発光層を備えた有機ＥＬ素子において、下記一般式［６］

【化７】

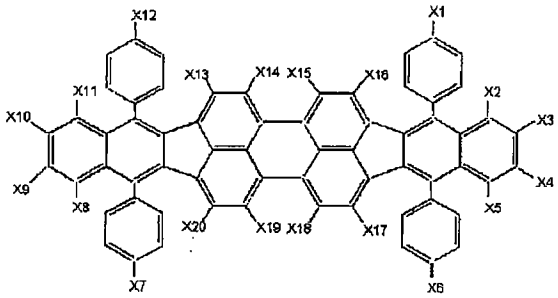
一般式［６］



［一般式［６］中のＲ１～Ｒ２８は、それぞれ独立に水素原子、ハロゲン原子、置換若しくは未置換のアルキル基、置換若しくは未置換のアルコキシ基、置換若しくは未置換のアリール基、又は、置換若しくは未置換のアミノ基を表す。Ｒ１～Ｒ４、Ｒ５～Ｒ８は、互いに結合して飽和若しくは不飽和の５員環又は６員環を形成してもよい。］で示される芳香族アミン誘導体と、下記一般式［２］

【化８】

一般式［２］



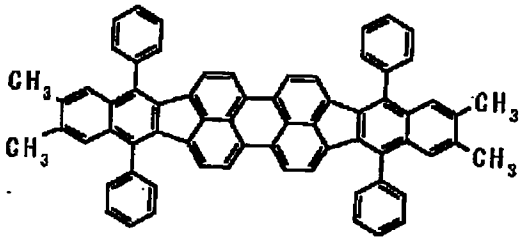
［一般式［２］中のＸ１～Ｘ２０は、それぞれ独立に水素原子、ハロゲン原子、置換若しくは未置換のアルキル基、置換若しくは未置換のアルコキシ基、置換若しくは未置換のアリール基、又は、置換若しくは未置換のアミノ基を表す。Ｘ１～Ｘ２０は、互いに結合して飽和若しくは不飽和の５員環又は６員環を形成してもよい。］で示されるジベンゾ｛［ｆ，ｆ’］－４，４’，７，７’－テトラフェニル｝ジインデノ［１，２，３－ｃｄ：１’，２’，３’－ｌｍ］ペリレン誘導体とを混合させた少なくとも１層の発光層を有していることを特徴とする有機ＥＬ素子。

【請求項５】　一般式［２］のジベンゾ｛［ｆ，ｆ’］

［1，2，3－ｃｄ：1’，2’，3’－ｌｍ］ペリレン誘導体が下記式［２ａ］で示される化合物であることを特徴とする請求項１～４のいずれか１項に記載の有機ＥＬ素子。

【化９】

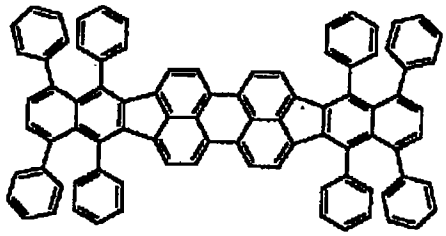
式［2 a］



【請求項６】　一般式［２］のジベンゾ｛［ｆ，ｆ’］－４，４’，７，７’－テトラフェニル｝ジインデノ［1，2，3－ｃｄ：1’，2’，3’－ｌｍ］ペリレン誘導体が下記式［２ｂ］で示される化合物であることを特徴とする請求項１～４のいずれか１項に記載の有機ＥＬ素子。

【化１０】

式［２ｂ］

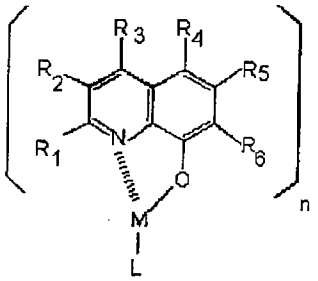


【請求項７】　一般式［１］、［４］、［５］又は［６］の芳香族アミン誘導体をホストとし、これに一般式［２］のジベンゾ｛［ｆ，ｆ’］－４，４’，７，７’－テトラフェニル｝ジインデノ［1，2，3－ｃｄ：1’，2’，3’－ｌｍ］ペリレン誘導体がドープされており、ドープ比率が１～１０％であることを特徴とする請求項１～６のいずれか１項に記載の有機ＥＬ素子。

【請求項８】　電子注入層又は電子輸送層が、下記一般式［3］

【化１１】

一般式［3］



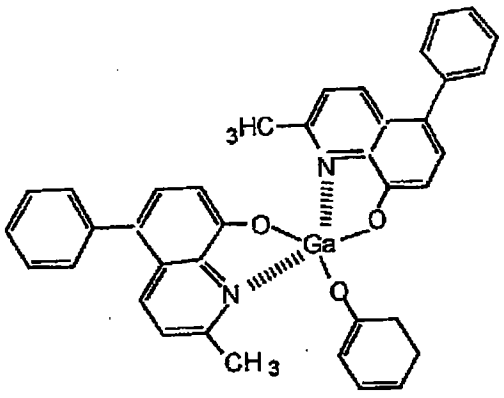
［一般式［３］中のMは金属原子を表す。R1～R6は、それぞれ独立に水素原子、ハロゲン原子、置換若しくは未置換のアルキル基、置換若しくは未置換のアルコキシ基、置換若しくは未置換のアリール基、置換若しくは未置換のアリールオキシ基、置換若しくは未置換のシクロアルキル基又はシアノ基を表す。Ｌは、ハロゲン原子、置換若しくは未置換のアルコキシ基、置換若しくは未置換のアリールオキシ基、置換若しくは未置換のアルキル基、置換若しくは未置換のアリールオキシ基又は置換若しくは未置換のシクロアルキル基を有する配位子を表す。］で示される有機金属錯体を含むことを特徴とする請求項１～７のいずれか１項に記載の有機ＥＬ素子。

【請求項９】　一般式［３］の有機金属錯体においてR4がアリール基であることを特徴とする請求項８に記載の有機ＥＬ素子。

【請求項１０】　一般式［３］の有機金属錯体が下記式［３ａ］で示される化合物であることを特徴とする請求項９に記載の有機ＥＬ素子。

【化１２】

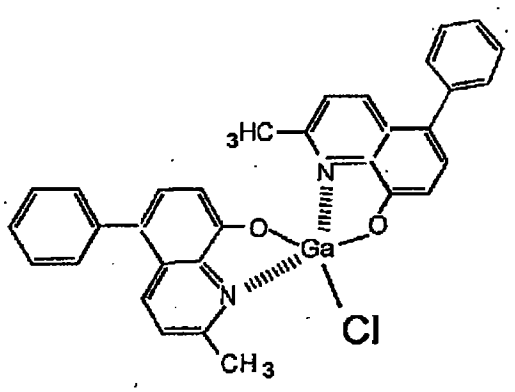
式［３ａ］



【請求項１１】　一般式［３］の有機金属錯体が下記式［３ｂ］で示される化合物であることを特徴とする請求項９に記載の有機ＥＬ素子。

【化１３】

式［3b］

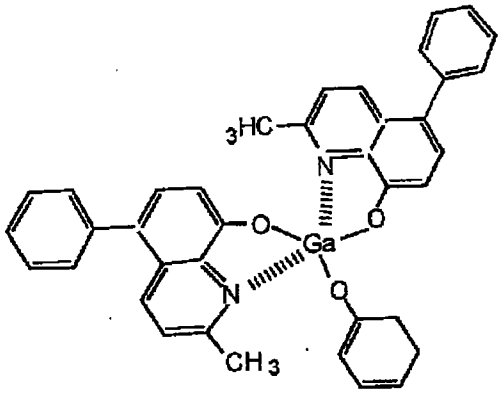


【請求項１２】　電子注入層又は電子輸送層が、一般式［3］で示される有機金属錯体を複数種含むことを特徴とする請求項８～１１のいずれか１項に記載の有機ＥＬ素子。

【請求項１３】　電子注入層又は電子輸送層が、下記式［３ａ］で示される化合物及び下記式［３ｂ］で示される化合物を含むことを特徴とする請求項１２に記載の有機ＥＬ素子。

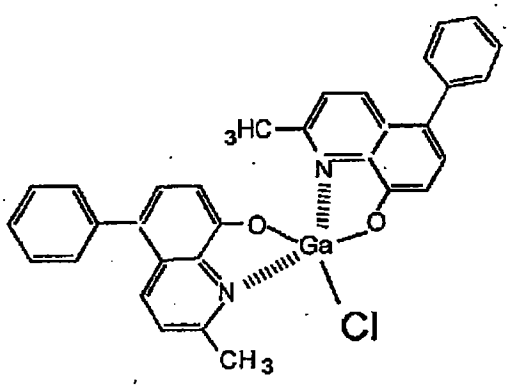
【化１４】

式［3a］



【化１５】

式［3b］



【請求項１４】　電子注入層又は電子輸送層が、下記一

$(Q)_3-Al$ …　［a］

［一般式［a］中のQは、置換若しくは未置換の８－キノリノラート配位子を表す。］で示される発光性有機アルミニウム錯体を含むことを特徴とする請求項１～１３のいずれか１項に記載の有機ＥＬ素子。

【請求項１５】　請求項１～１４のいずれか１項に記載の有機ＥＬ素子を搭載したことを特徴とする有機ＥＬディスプレイ。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は有機ＥＬ素子（有機エレクトロルミネッセンス素子）に関し、さらに詳述すると、発光効率に優れ、輝度、色度の良好な赤色有機ＥＬ素子及びそれを用いた有機ＥＬディスプレイに関する。

【０００２】

【従来の技術】従来、有機ＥＬ素子、特に赤色有機ＥＬ素子においては、実用レベルの輝度を得るために、一般的に使用されている蛍光量子収率の高い下記一般式

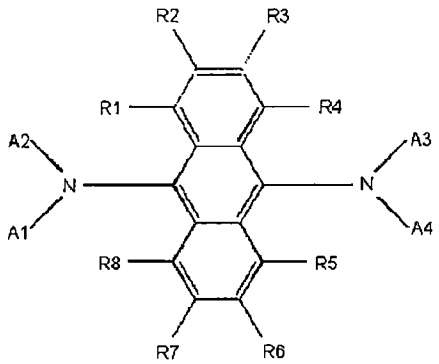
［a］

$(Q)_3-Al$ …　［a］

［一般式［a］中のQは、置換若しくは未置換の８－キノリノラート配位子を表す。］の発光性有機アルミニウム錯体や、下記一般式［b］

【化１６】

一般式［b］

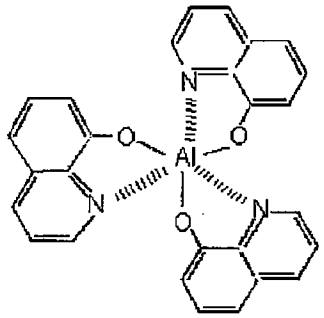


［一般式［b］中のA1～A4は、それぞれ独立に炭素数６～１８のアリール基を表す。R1～R8は、それぞれ独立に水素原子、ハロゲン原子、アルキル基、アルコキシ基、アリール基又はアミノ基を表す。］の芳香族アミン誘導体をホストとし、これに赤色材料をドーピングしたものを発光層としていた。

【０００３】例えば、C.W.Tang: “An Overview of Organic Electroluminescent Materialsand Devices”,SID 96DIGEST.,14.1,pp.181-184(1996)に記載の有機ＥＬ素子では、発光性有機アルミニウム錯体である下記化合物4

【化１７】

化合物４



のトリス（８－キノリノラート）アルミニウムをホストとし、これに赤色発光材料のＤＣＪＴをドープすることにより発光層としている。また、特開平１０－７２５８１では、前記一般式［ｂ］に示した芳香族アミン誘導体をホストとし、これに赤色発光材料をドープすることにより発光層としている。

【０００４】ところで、実用的観点から、現状の有機ＥＬ素子は長寿命化、熱的安定性が必須であり、そのために陽極とホール輸送層との間に、高耐熱化用ホール注入層を使用していた。しかし、これにより寿命特性が向上する反面、発光層へのホール注入特性が悪化していた。その結果、発光層での再結合収率が低下し、十分な発光効率が得られなかった。さらに、印加電圧の関係で電子が発光層から漏れるという問題、つまりキャリアバランスが変化し、ホール輸送層そのものが発光することにより色合いが変化するという問題があった。

【０００５】ここで、従来の有機ＥＬ素子について図面を参照しながら説明する。図５は有機ＥＬ素子の断面図である。図５において従来の有機ＥＬ素子は、ガラス基板１上にＩＴＯ（インジウムースズ酸化物）からなる陽極（透明電極）２を形成し、この上にホール注入層３、ホール輸送層４、発光層５、電子輸送層６などの有機ＥＬ層及び陰極７等を形成することにより構成されている。ここで発光層５には、蛍光量子収率の高い発光性有機アルミニウム錯体（一般式［ａ］）をホストとし、これに赤色材料がドープされている。また、このとき電子輸送層６として電子輸送性のある発光性有機アルミニウム錯体（一般式［ａ］）を用いることもある。

【０００６】

【発明が解決しようとする課題】従来、高耐熱化用ホール注入層を使用していることから、寿命特性が向上する反面、発光層へのホール注入特性が悪化していた。このことは発光層におけるホールー電子の再結合収率の低下を招き、十分な発光効率が得られないという問題を引き起こしていた。さらには、電圧増加に伴って電子が発光層から漏れ出し、ホール輸送層そのものが発光することにより色合いが変化するという問題もあった。よって、従来の素子構成では、発光効率に優れ、高輝度でかつ常時色度の安定した有機ＥＬデバイスを提供することができ、また電圧が増加すると電子輸送性が変化し、本来発光層で起きるべきホールー電子の再結合が、ホール輸送層中で起きてしまうからであった。

【０００７】本発明は、前述した事情に鑑みてなされたもので、発光効率に優れ、輝度、色度の良好な赤色有機ＥＬ素子を提供することを目的とする。

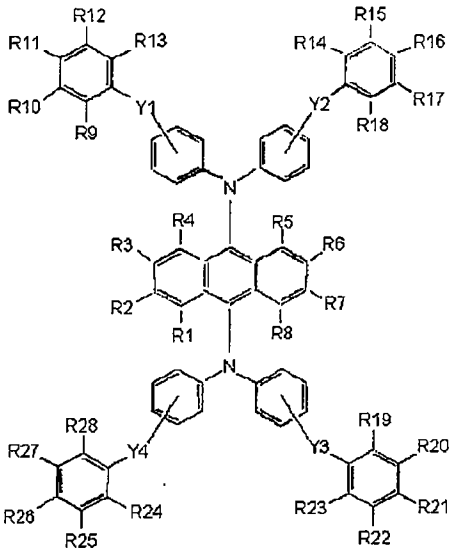
【０００８】

【課題を解決するための手段】本発明は、前記目的を達成するため、下記（１）～（１５）に示す有機ＥＬ素子及び有機ＥＬディスプレイを提供する。

【０００９】（１）互いに対向する陽極と陰極間に、少なくとも単層又は複数層の有機薄膜よりなる発光層を備えた有機ＥＬ素子において、下記一般式［１］

【化１８】

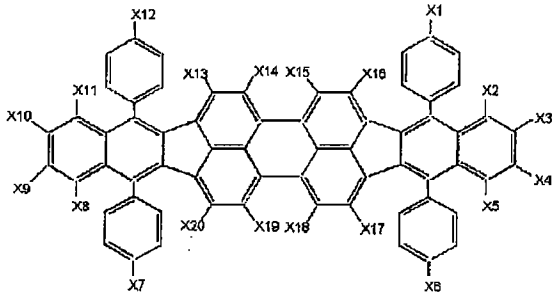
一般式［１］



［一般式［１］中のＲ1～Ｒ28は、それぞれ独立に水素原子、ハロゲン原子、置換若しくは未置換のアルキル基、置換若しくは未置換のアルコキシ基、置換若しくは未置換のアリール基、又は、置換若しくは未置換のアミノ基を表す。Ｙ1～Ｙ4は、それぞれ独立にＯ、Ｓ、SO_2、Ｃ＝Ｏ、CH_2O、CH_2OCH_2、又は、置換若しくは未置換のアルキレン基を表す。Ｒ1～Ｒ4、Ｒ5～Ｒ8は、互いに結合して飽和若しくは不飽和の５員環又は６員環を形成してもよい。］で示される芳香族アミン誘導体と、下記一般式［２］

【化１９】

一般式［２］

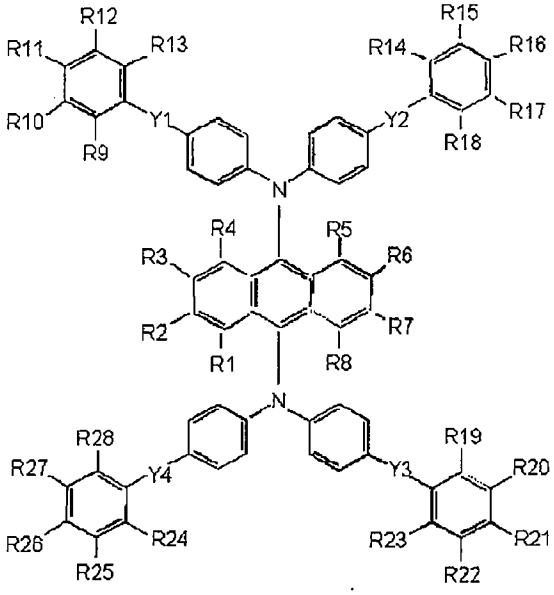


［一般式［２］中のＸ1～Ｘ20は、それぞれ独立に水素原子、ハロゲン原子、置換若しくは未置換のアルキル基、置換若しくは未置換のアルコキシ基、置換若しくは未置換のアリール基、又は、置換若しくは未置換のアミノ基を表す。Ｘ1～Ｘ20は、互いに結合して飽和若しくは不飽和の５員環又は６員環を形成してもよい。］で示されるジベンゾ｛［ｆ，ｆ’］－４，４’，７，７’－テトラフェニル｝ジインデノ［１，２，３－ｃｄ：１’，２’，３’－ｌｍ］ペリレン誘導体とを混合させた少なくとも１層の発光層を有していることを特徴とする有機ＥＬ素子。

【００１０】（２）互いに対向する陽極と陰極間に、少なくとも単層又は複数層の有機薄膜よりなる発光層を備えた有機ＥＬ素子において、下記一般式［４］

【化２０】

一般式［４］

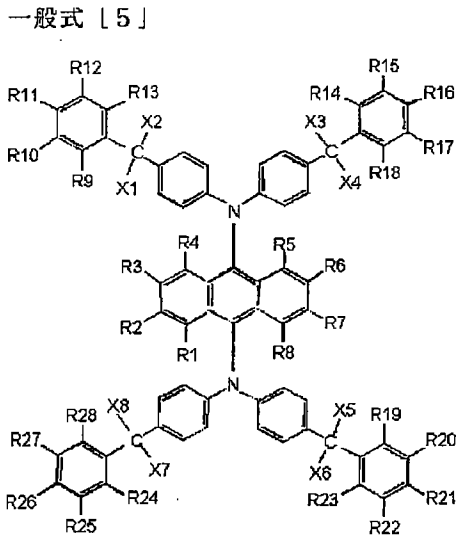


［一般式［４］中のＲ1～Ｒ28は、それぞれ独立に水素原子、ハロゲン原子、置換若しくは未置換のアルキル基、置換若しくは未置換のアルコキシ基、置換若しくは未置換のアリール基、又は、置換若しくは未置換のアミノ基を表す。Ｙ1～Ｙ4は、それぞれ独立にＯ、Ｓ、SO_2、Ｃ＝Ｏ、CH_2O、CH_2OCH_2、又は、置換若しくは未置換のアルキレン基を表す。Ｒ1～Ｒ4、Ｒ5～Ｒ8は、互いに結合して飽和若しくは不飽和の５員環又は６員体と、前記一般式［２］で示されるジベンゾ｛［ｆ，ｆ’］－４，４’，７，７’－テトラフェニル｝ジインデノ［１，２，３－ｃｄ：１’，２’，３’－ｌｍ］ペリレン誘導体とを混合させた少なくとも１層の発光層を有していることを特徴とする有機ＥＬ素子。

【００１１】（３）互いに対向する陽極と陰極間に、少なくとも単層又は複数層の有機薄膜よりなる発光層を備えた有機ＥＬ素子において、下記一般式［５］

【化２１】

一般式［５］

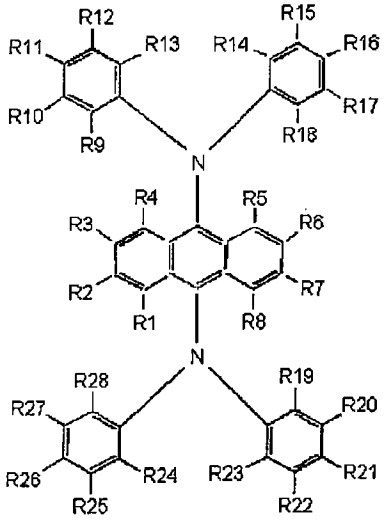


［一般式［５］中のＲ1～Ｒ28は、それぞれ独立に水素原子、ハロゲン原子、置換若しくは未置換のアルキル基、置換若しくは未置換のアルコキシ基、置換若しくは未置換のアリール基、又は、置換若しくは未置換のアミノ基を表す。Ｘ1～Ｘ8は、置換若しくは未置換の炭素数１～２０のアルキル基、又は、置換若しくは未置換の炭素数６～１６のアリール基を表す。Ｒ1～Ｒ4、Ｒ5～Ｒ8は、互いに結合して飽和若しくは不飽和の５員環又は６員環を形成してもよい。］で示される芳香族アミン誘導体と、前記一般式［２］で示されるジベンゾ｛［ｆ，ｆ’］－４，４’，７，７’－テトラフェニル｝ジインデノ［１，２，３－ｃｄ：１’，２’，３’－ｌｍ］ペリレン誘導体とを混合させた少なくとも１層の発光層を有していることを特徴とする有機ＥＬ素子。

【００１２】（４）互いに対向する陽極と陰極間に、少なくとも単層又は複数層の有機薄膜よりなる発光層を備えた有機ＥＬ素子において、下記一般式［６］

【化２２】

一般式［６］

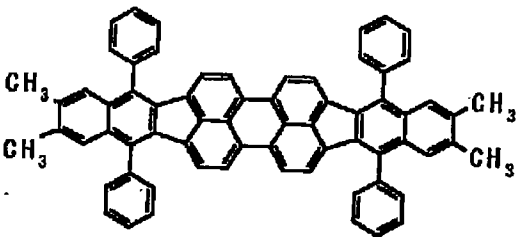


［一般式［６］中のＲ1～Ｒ28は、それぞれ独立に水素原子、ハロゲン原子、置換若しくは未置換のアルキル基、置換若しくは未置換のアルコキシ基、置換若しくは未置換のアリール基、又は、置換若しくは未置換のアミノ基を表す。Ｒ1～Ｒ4、Ｒ5～Ｒ8は、互いに結合して飽和若しくは不飽和の５員環又は６員環を形成してもよい。］で示される芳香族アミン誘導体と、前記一般式［２］で示されるジベンゾ｛［ｆ，ｆ’］－４，４’，７，７’－テトラフェニル｝ジインデノ［１，２，３－ｃｄ：１’，２’，３’－ｌｍ］ペリレン誘導体とを混合させた少なくとも１層の発光層を有していることを特徴とする有機ＥＬ素子。

【００１３】（５）一般式［２］のジベンゾ｛［ｆ，ｆ’］－４，４’，７，７’－テトラフェニル｝ジインデノ［１，２，３－ｃｄ：１’，２’，３’－ｌｍ］ペリレン誘導体が下記式［２ａ］で示される化合物であることを特徴とする（１）～（４）の有機ＥＬ素子。

【化２３】

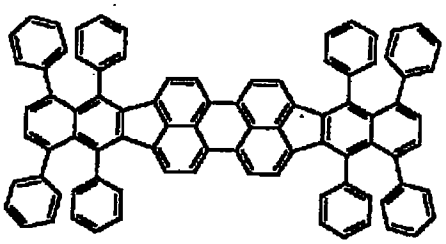
式［２ａ］



【００１４】（６）一般式［２］のジベンゾ｛［ｆ，ｆ’］－４，４’，７，７’－テトラフェニル｝ジインデノ［１，２，３－ｃｄ：１’，２’，３’－ｌｍ］ペリレン誘導体が下記式［２ｂ］で示される化合物であることを特徴とする（１）～（４）の有機ＥＬ素子。

【化２４】

式［２ｂ］

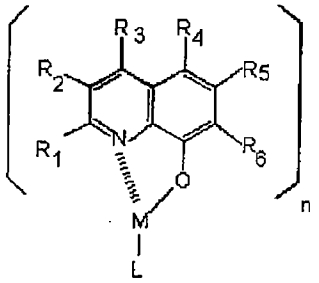


【００１５】（７）一般式［１］、［４］、［５］又は［６］の芳香族アミン誘導体をホストとし、これに一般式［２］のジベンゾ｛［ｆ，ｆ’］－４，４’，７，７’－テトラフェニル｝ジインデノ［１，２，３－ｃｄ：１’，２’，３’－ｌｍ］ペリレン誘導体がドープされており、ドープ比率が１～１０％であることを特徴とする（１）～（６）の有機ＥＬ素子。

【００１６】（８）電子注入層又は電子輸送層が、下記一般式［３］

【化２５】

一般式［３］



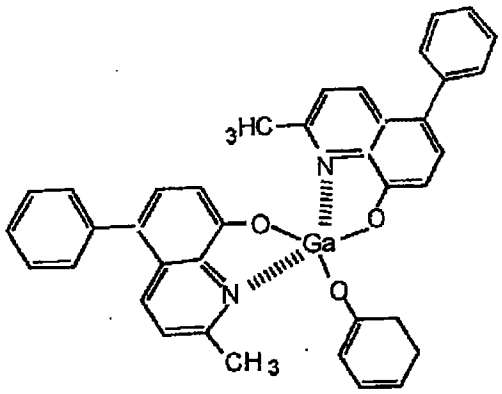
［一般式［３］中のＭは金属原子を表す。Ｒ1～Ｒ6は、それぞれ独立に水素原子、ハロゲン原子、置換若しくは未置換のアルキル基、置換若しくは未置換のアルコキシ基、置換若しくは未置換のアリール基、置換若しくは未置換のアリールオキシ基、置換若しくは未置換のシクロアルキル基又はシアノ基を表す。Ｌは、ハロゲン原子、置換若しくは未置換のアルコキシ基、置換若しくは未置換のアリールオキシ基、置換若しくは未置換のアルキル基、置換若しくは未置換のアリールオキシ基又は置換若しくは未置換のシクロアルキル基を有する配位子を表す。］で示される有機金属錯体を含むことを特徴とする（１）～（７）の有機ＥＬ素子。

【００１７】（９）一般式［３］の有機金属錯体においてＲ4がアリール基であることを特徴とする（８）の有機ＥＬ素子。

【００１８】（１０）一般式［３］の有機金属錯体が下記式［３ａ］で示される化合物であることを特徴とする（９）の有機ＥＬ素子。

【化２６】

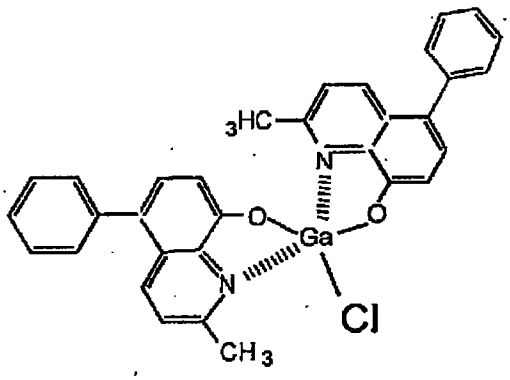
式［３ａ］



【００１９】（１１）一般式［３］の有機金属錯体が下記式［３ｂ］で示される化合物であることを特徴とする（９）の有機ＥＬ素子。

【化２７】

式［３ｂ］



【００２０】（１２）電子注入層又は電子輸送層が、一般式［３］で示される有機金属錯体を複数種含むことを特徴とする（８）～（１１）の有機ＥＬ素子。

【００２１】（１３）電子注入層又は電子輸送層が、前記式［３ａ］で示される化合物及び前記式［３ｂ］で示される化合物を含むことを特徴とする（１２）の有機ＥＬ素子。

【００２２】（１４）電子注入層又は電子輸送層が、下記一般式［ａ］

（Ｑ）$_3$－Ａｌ　…　［ａ］

［一般式［ａ］中のＱは、置換若しくは未置換の８－キノリノラート配位子を表す。］で示される発光性有機アルミニウム錯体を含むことを特徴とする（１）～（１３）の有機ＥＬ素子。

【００２３】（１５）前記（１）～（１４）の有機ＥＬ素子を搭載したことを特徴とする有機ＥＬディスプレイ。

【００２４】本発明は、発光層において、一般式［１］、［４］、［５］、［６］で示される芳香族アミン誘導体と、一般式［２］で示される赤色発光材料のジェニル｝ジインデノ［１，２，３－ｃｄ：１’，２’，３’－１ｍ］ペリレン誘導体とを混合させることによって、より良好なホール輸送性能（電子ブロック性能）を持たせることや、赤色発光材料の濃度消光などを適度に抑制させることができ、その結果、発光効率に優れ、輝度、色度の良好な赤色有機ＥＬ素子を得ることができる。

【００２５】また、緑色発光材料として長寿命特性を有する前記芳香族アミン誘導体と、非結晶材料の前記ジベンゾ｛［ｆ，ｆ’］－４，４’，７，７’－テトラフェニル｝ジインデノ［１，２，３－ｃｄ：１’，２’，３’－１ｍ］ペリレン誘導体とを使用していることからも、さらに寿命特性の向上が図れる。

【００２６】さらに、電子注入層あるいは電子輸送層に一般式［３］で示される有機金属錯体を複数種含有させると、輝度を高く保持することができる。すなわち、電子注入層あるいは電子輸送層において上記有機金属錯体を１種類だけ使用した場合は、高温下で長時間使用すると薄膜の凝集や結晶化が進行し、電子注入特性あるいは電子輸送特性が低下する傾向がある。これに対し、上記有機金属錯体を２種類以上含有させると非晶質性（アモルファス性）が高くなるため、長時間使用しても凝集、結晶化が生じにくく、そのため電子注入特性あるいは電子輸送特性の低下を抑制することができる。

【００２７】

【発明の実施の形態】次に、本発明の実施形態について図面を参照して詳細に説明する。図１は本発明の一実施形態を示す有機ＥＬ素子の概略断面図である。図１においてこの有機ＥＬ素子は、ガラス基板１上にＩＴＯ（インジウムースズ酸化物）からなる陽極（透明電極）２を形成し、この上にホール注入層３、ホール輸送層４、発光層５、電子輸送層６などの有機ＥＬ層及び陰極７等を形成することにより構成されている。素子には耐熱性を持たせるため、ホール注入層３として高耐熱化用ホール注入層を設けてある。

【００２８】ここで、本発明の素子において発光層５に対し、一般式［１］の芳香族アミン誘導体と、赤色発光材料である一般式［２］のジベンゾ｛［ｆ，ｆ’］－４，４’，７，７’－テトラフェニル｝ジインデノ［１，２，３－ｃｄ：１’，２’，３’－１ｍ］ペリレン誘導体とを混合させて使用する。このとき、ジベンゾ｛［ｆ，ｆ’］－４，４’，７，７’－テトラフェニル｝ジインデノ［１，２，３－ｃｄ：１’，２’，３’－１ｍ］ペリレン誘導体のドープ量は蒸着レートで制御しており、色素自体の濃度消光を抑制するために、ドープ量は前記芳香族アミン誘導体に対して１～１０％程度にするのが好ましい。

【００２９】ところで、本発明の一般式［１］で示される化合物は公知の方法で合成することができる。例え

置換若しくは未置換のアミン誘導体と、炭酸カリウム、炭酸ナトリウム、水酸化カリウム、水酸化ナトリウム等とを、ベンゼン、トルエン又はキシレン等の溶媒下で反応させることにより合成することができる。触媒として、銅粉、塩化第一銅、スズ、塩化第一スズ、ピリジン等がある。また、本発明の一般式［２］で示される化合物も公知の方法で合成することができる。例えば、ベンゾ［ｋ］フルオランテン誘導体を塩化アルミニウム／塩化ナトリウム、フッ化コバルト、トリフルオロ酢酸タリウム等の存在下で反応させることにより合成することができる。

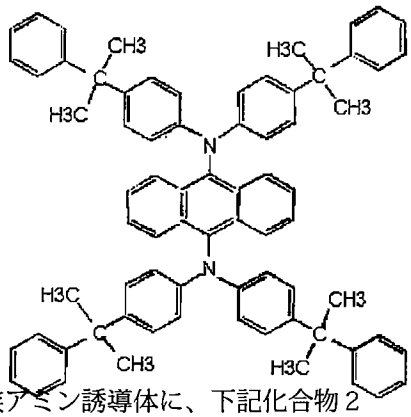
【００３０】次に、電子輸送層６に対し、一般式［３］で示されるイオン化ポテンシャルの大きい有機金属錯体を使用することにより、電子輸送層におけるホールブロック性能をさらに大きくすることができる。一般式［３］で示される電子輸送材料は、公知の方法で合成することができる。例えば、ガリウム化合物と一般式［３］の括弧内及びＬの配位子残基を有する化合物を原料として合成することができる。すなわち、アルキルガリウム、ガリウムアルコキシド、ハロゲン化ガリウム、窒化ガリウム、酸化ガリウム等に、一般式［３］の括弧内の配位子として８－ヒドロキシキノリン、２－メチル－８－ヒドロキシキノリン等のキノリン残基を２配位、Ｌの配位子としてハロゲン原子、置換若しくは未置換のアルコキシ基、アリールオキシ基、アルキル基を有する残基を１配位、メタノール、エタノールベンゼン、トルエン、テトラヒドロフラン等の溶媒下で反応させる。

【００３１】以下、本発明について実施例を参照して説明するが、本発明の要旨を変更しない限り、本発明は以下の実施例に限定されるものではない。

【００３２】（実施例１）本実施例の有機ＥＬ素子は、発光層５として下記化合物１

【化２８】

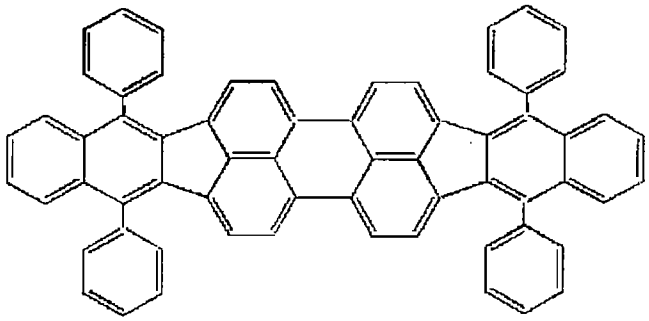
化合物１



の芳香族アミン誘導体に、下記化合物２

【化２９】

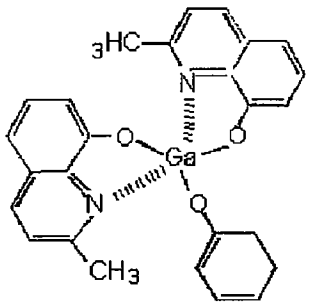
化合物２



のジベンゾテトラフェニルペリフランテンを蒸着レート比で２．５％ドープした。電子輸送層６については、下記化合物３

【化３０】

化合物３



のガリウム金属錯体を成膜することにより作製した。その結果、電流効率６ｃｄ／Ａ以上（～１，０００ｃｄ／Ａ）、赤色発光が得られた。また、この素子は色度安定性も良好で、印加電圧に伴う色合いの変化が小さかった。

【００３３】ここで図２に、本発明素子の印加電圧に伴う色合いの変化を従来素子と比較して示す。図中横軸は印加電圧（Ｖ）を示し、縦軸はＣＩＥ色度座標のＸ又はＹ座標を示してある。これより、本発明素子は色度Ｘにおいて、従来素子に比べ印加電圧が増加しても色合いの変化が抑えられているのが判る。

【００３４】さらに、本発明素子に関しては寿命特性が向上しており、５ｍＡ／ｃｍ^{2}の定電流駆動において良好な結果が得られている。図３に本発明素子の素子寿命特性を示す。図中横軸は駆動時間（Ｈｒ）を示し、縦軸は相対輝度を示してある。これより、本発明素子は、３，０００時間経過しても初期輝度の９０％以上を維持するほどの寿命特性であることが判る。また、ダークスポット（非発光部）もほとんど観察されなかった。

は、発光層として前記化合物１の芳香族アミン誘導体に、赤色発光材料を重量比で１％添加することにより、実施例１とほぼ同レベルの最大発光効率４１ｍ／Ｗ、最高輝度３８，０００ｃｄ／ｍ²の赤色発光が得られている。しかしながら、この素子の寿命は短く、３ｍＡ／ｃｍ²の連続発光で、１，０００時間程度しか安定な発光は確認されておらず、実用化は困難である。

【００３６】（比較例２）特開平１０－３３０２９５では、発光層として前記化合物２のジベンゾテトラフェニルペリフランテンを単独で用いた場合、１５Ｖの直流電圧の印加で輝度１，２５０ｃｄ／ｍ²の赤色発光が得られている。また、４，４’－ビス〔Ｎ－フェニル－Ｎ－（１”－ナフチル）アミノ〕ビフェニルに、前記化合物２のジベンゾテトラフェニルペリフランテンを重量比で５％添加することにより、１５Ｖの直流電圧の印加で輝度２，６５０ｃｄ／ｍ²の赤色発光が得られている。しかしながら、何れの例も本発明の素子に比べると非常に輝度が低く、実用化は困難である。

【００３７】（比較例３）特開平１１－２３３２６１では、発光層として前記化合物４のトリス（８－キノリノラート）アルミニウムに、前記化合物２のジベンゾテトラフェニルペリフランテンを重量比で８％添加することにより、印加電圧９．７Ｖで約５２ｃｄ／ｍ²の赤色発光が得られている。この素子における２，７００時間の連続一定電流動作後の輝度は、３０ｃｄ／ｍ²までに減衰している。よって、本発明の素子に比べると非常に輝度が低く、寿命も短いことから、実用化は困難である。

【００３８】（比較例４）特開平１０－８８１２１では、一般式［３］に示す金属錯体を発光層あるいは電子注入層として用いている。例えば、前記化合物３のガリウム金属錯体を電子注入層として用いた場合、直流電圧８Ｖで輝度１，５０００ｃｄ／ｍ²、発光効率２．３５ｌｍ／Ｗの青緑色発光が得られている。しかしながら、本発明では一般式［３］に示す金属錯体を赤色素子の電子輸送層として用いることにより、高輝度、高効率、長寿命及び色度安定性をさらに向上させている。

【００３９】（比較例５）特許公報第２８２８８２１号では、発光層にペリノン誘導体、電子輸送層にガリウム金属錯体であるトリス（２－メチル－８－キノリノラート）ガリウムを用いた素子について開示している。この素子は、１６Ｖの直流電圧の印加で輝度８５０ｃｄ／ｍ²の黄色発光が確認されており、発光寿命は４日間である。したがって、本発明の素子に比べると非常に輝度が低く、寿命も極めて短い。

【００４０】（実施例２）電子輸送層６として、前記化合物４のトリス（８－キノリノラート）アルミニウムを使用する以外は、実施例１と同様の方法で有機ＥＬ素子を作製した。この有機ＥＬ素子の陽極２と陰極７の間に直流電圧を印加したところ、電流効率５ｃｄ／Ａ以上ｄ／ｍ²の赤色発光が得られた。

【００４１】（実施例３）発光層５として、前記化合物１の芳香族アミン誘導体に、前記式［２ｂ］のジベンゾ［ｆ，ｆ’］ジインデノ［１，２，３－ｃｄ：１’，２’，３’－ｌｍ］ペリレン誘導体を使用する以外は、実施例１と同様の方法で有機ＥＬ素子を作製した。この有機ＥＬ素子の陽極２と陰極７の間に直流電圧を印加したところ、電流効率５ｃｄ／Ａ以上（～１，０００ｃｄ／ｍ²）、最高輝度３３，０００ｃｄ／ｍ²の赤色発光が得られた。

【００４２】（実施例４）本実施例の有機ＥＬ素子は、発光層５として前記化合物１の芳香族アミン誘導体に、前記式［２ｂ］の化合物を蒸着レート比で２．５％ドープした。電子輸送層６については、前記式［３ａ］のガリウム金属錯体を成膜することにより作製した。この有機ＥＬ素子の陽極２と陰極７の間に直流電圧を印加したところ、電流効率６．８ｃｄ／Ａ以上（～１，０００ｃｄ／ｍ²）、最高輝度４５，０００ｃｄ／ｍ²の赤色発光が得られた。

【００４３】（実施例５）電子輸送層６について、前記式［３ａ］及び式［３ｂ］のガリウム金属錯体を混合して成膜すること以外は、実施例４と同様の方法で有機ＥＬ素子を作製した。式［３ａ］のガリウム金属錯体：式［３ｂ］のガリウム金属錯体の混合比は重量比で９：１とした。この有機ＥＬ素子の陽極２と陰極７の間に直流電圧を印加したところ、電流効率６．６ｃｄ／Ａ以上（～１，０００ｃｄ／ｍ²）、最高輝度４３，０００ｃｄ／ｍ²の赤色発光が得られた。

【００４４】（実施例６）電子輸送層６について、前記化合物３のガリウム金属錯体を成膜すること以外は、実施例４と同様の方法で有機ＥＬ素子を作製した。この有機ＥＬ素子の陽極２と陰極７の間に直流電圧を印加したところ、電流効率６ｃｄ／Ａ以上（～１，０００ｃｄ／ｍ²）、最高輝度３８，０００ｃｄ／ｍ²の赤色発光が得られた。

【００４５】（実施例７）本実施例の有機ＥＬ素子は、発光層５として前記化合物１の芳香族アミン誘導体に、前記式［２ａ］の化合物を蒸着レート比で２．５％ドープした。電子輸送層６については、前記式［３ａ］のガリウム金属錯体を成膜することにより作製した。この有機ＥＬ素子の陽極２と陰極７の間に直流電圧を印加したところ、電流効率６．５ｃｄ／Ａ以上（～１，０００ｃｄ／ｍ²）、最高輝度４２，０００ｃｄ／ｍ²の赤色発光が得られた。

【００４６】（実施例８）電子輸送層６について、前記式［３ａ］及び式［３ｂ］のガリウム金属錯体を混合して成膜すること以外は、実施例７と同様の方法で有機ＥＬ素子を作製した。式［３ａ］のガリウム金属錯体：式［３ｂ］のガリウム金属錯体の混合比は重量比で９：１

電圧を印加したところ、電流効率６．４ｃｄ／Ａ以上（～１，０００ｃｄ／ｍ²）、最高輝度４１，０００ｃｄ／ｍ²の赤色発光が得られた。

【００４７】（実施例９）電子輸送層６について、前記化合物３のガリウム金属錯体を成膜すること以外は、実施例７と同様の方法で有機ＥＬ素子を作製した。この有機ＥＬ素子の陽極２と陰極７の間に直流電圧を印加したところ、電流効率５．８ｃｄ／Ａ以上（～１，０００ｃｄ／ｍ²）、最高輝度３７，０００ｃｄ／ｍ²の赤色発光が得られた。

【００４８】実施例１、４～８の有機ＥＬ素子の特性を表１に示す。

【表１】

	室温寿命 *1 (時間)	100cd/m²時効率 (cd/A)	最高輝度 (cd/m²)	85℃寿命 *1 (時間)	色度@1000cd/m²
実施例1	10000	6	38000	500	(0.62, 0.38)
実施例4	15000	6.8	45000	1900	(0.63, 0.36)
実施例5	16000	6.6	43000	2000以上	(0.63, 0.37)
実施例6	10000	6	38000	700	(0.63, 0.37)
実施例7	12000以上	6.5	42000	1600	(0.62, 0.37)
実施例8	12000以上	6.4	41000	2000以上	(0.62, 0.37)
実施例9	10000	5.8	37000	600	(0.62, 0.38)

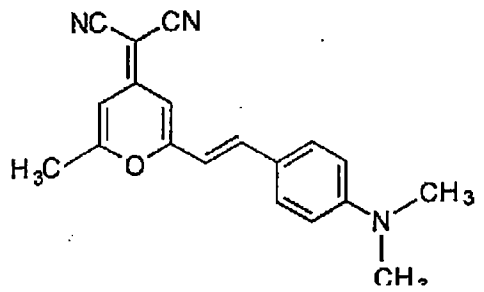
*1:初期 200cd/m²

【００４９】（実施例１０）本実施例の有機ＥＬ素子は、発光層５として前記化合物１の芳香族アミン誘導体に、前記化合物２のジベンゾテトラフェニルペリフランテンを蒸着レート比で２．５％ドープした。電子輸送層６については、前記式［３ａ］のガリウム金属錯体を成膜することにより作製した。

【００５０】ここで図４に、実施例１０の素子のＬ－Ｖ特性及びＪ－Ｖ特性を従来素子と比較して示す。従来素子は、発光層５として前記化合物４のトリス（８－キノリノラート）アルミニウムに下記化合物５の赤色ドーパント（ＤＣＭ）をドープし、電子輸送層６については前記化合物４のトリス（８－キノリノラート）アルミニウムを成膜したものである。図４より、実施例１０の素子は、従来の赤色素子よりも低電圧化が可能であることがわかる。

【化３１】

化合物５



【００５１】以上説明した本実施例によれば、発光層において、特定の芳香族アミン誘導体と、赤色発光材料である特定のジベンゾ｛［ｆ，ｆ’］－４，４’，７，７’－テトラフェニル｝ジインデノ［１，２，３－ｃｄ：１’，２’，３’－ｌｍ］ペリレン誘導体とを混合させることにより、発光層においてより良好なホール輸送性能（電子ブロック性能）を持たせることができる。この結果、発光層へのホール注入特性が上がり、発光層でのホール－電子の再結合収率が向上し、高輝度が得られる。また、発光層自身が電子ブロック層の働きもするので、電子が発光層を抜けることなく、色純度も向上する。さらに、比較的に長寿命特性を有するトリフェニルジアミン誘導体と非結晶材料のジベンゾ｛［ｆ，ｆ’］－４，４’，７，７’－テトラフェニル｝ジインデノ［１，２，３－ｃｄ：１’，２’，３’－ｌｍ］ペリレン誘導体とを組み合わせることにより、格段に寿命特性が向上する。

【００５２】また、電子輸送層としてイオン化ポテンシャルの大きい有機金属錯体を用いることにより、本発明の発光層のイオン化ポテンシャルに対し、電子輸送層のイオン化ポテンシャルを大きくすることができる。その結果、電子輸送層へのホール漏れを制御できるので、発光層でのホール－電子の再結合収率はさらに向上する。

【００５３】本発明は前記実施例に限定されるものではなく、例えば一般式［１］に示す芳香族アミン誘導体と、一般式［２］に示す赤色発光材料であるジベンゾ｛［ｆ，ｆ’］－４，４’，７，７’－テトラフェニ

－１ｍ］ペリレン誘導体とを混合させた発光層において、一般式［２］のジベンゾ｛［ｆ，ｆ’］－４，４’，７，７’－テトラフェニル｝ジインデノ［１，２，３－ｃｄ：１’，２’，３’－１ｍ］ペリレン誘導体のドープ量の異なる発光層を２層以上設けることも可能である。また、このときのドープ量も１～１０％の範囲内に設定するのが好ましい。

【００５４】

【発明の効果】本発明は、以上のように構成され機能するので、従来に比べて、発光効率に優れ、輝度、色度の良好な赤色有機ＥＬ素子を得ることができる。また、寿命特性も格段に向上するので、長期的信頼性の高い有機ＥＬディスプレイを提供することができる。

【図面の簡単な説明】

【図１】本発明の一実施形態を示す有機ＥＬ素子の概略断面図である。

【図２】本発明素子の印加電圧に伴う色合いの変化を従来素子と比較して示すグラフである。

【図３】本発明素子の素子寿命特性を示すグラフである。

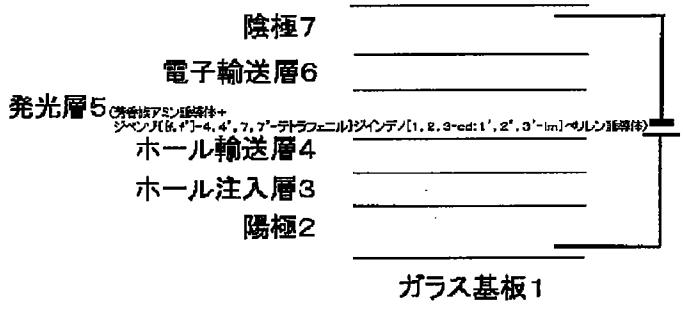
【図４】実施例１０の素子のＬ－Ｖ特性及びＪ－Ｖ特性を従来素子と比較して示すグラフである。

【図５】従来の有機ＥＬ素子の概略断面図である。

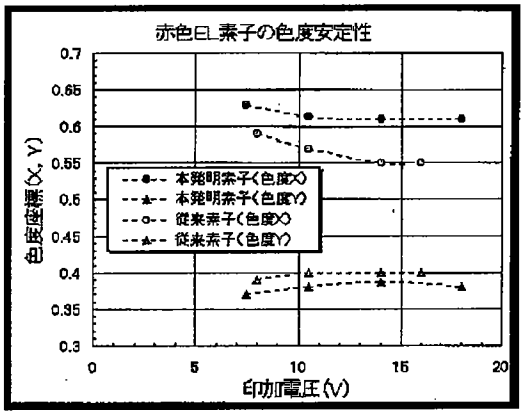
【符号の説明】

1　ガラス基板
2　陽極
3　ホール注入層
4　ホール輸送層
5　発光層
6　電子輸送層
7　陰極

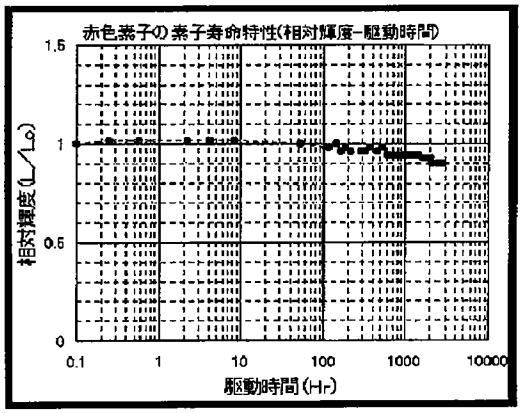
【図１】



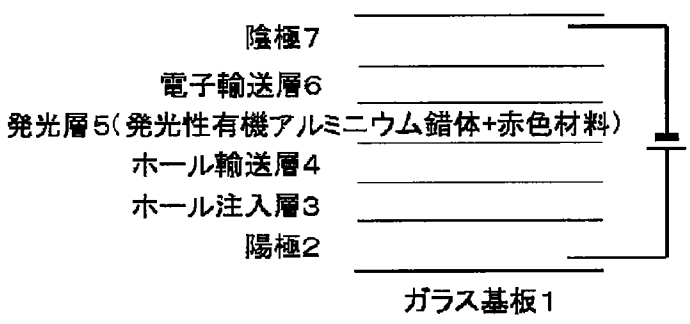
【図２】



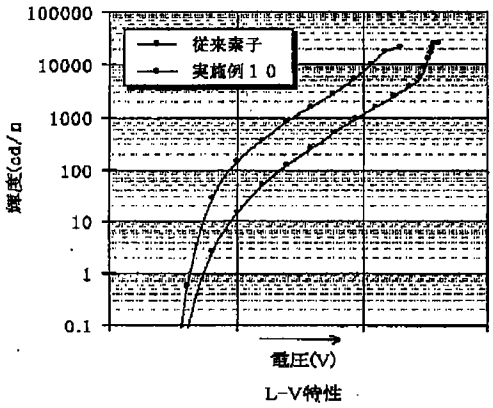
【図３】



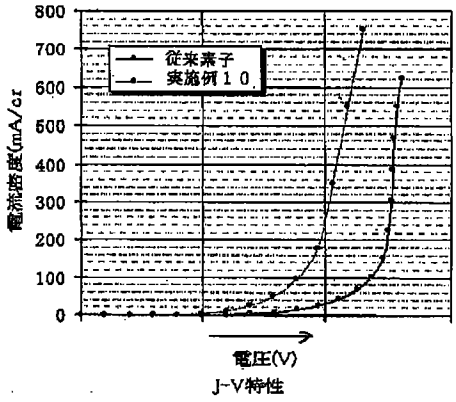
【図５】



【図４】


100000
10000
1000
100
10
1
0.1
輝度(cd/m
従来素子
実施例１０
電圧(V)

L-V特性


800
700
600
500
400
300
200
100
0
電流密度(mA/cr
従来素子
実施例１０
電圧(V)

J-V特性

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(51)Int.Cl. H05B 33/14

C09K 11/06

H05B 33/22

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(21)Application number : 2001-042102 (71)Applicant : NEC CORP

(22)Date of filing : 19.02.2001 (72)Inventor : MOTOMATSU TOSHIHIKO

SAKAGUCHI YOSHIKAZU

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(30)Priority

Priority number : 2000040925

Priority date : 18.02.2000

Priority country : JP

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(54) ORGANIC EL ELEMENT ORGANIC AND ORGANIC EL DISPLAY

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a red-color electroluminescent element which has a high utilization efficiency of electric energy, and which is superior in the chromatic purity compared with previous ones.

SOLUTION: Specific aromatic amine derivatives and dibenzo{[f,f']-4,4',7,7'-tetraphenyl}diindenol[1,2,3-cd:1'2',3'-lm]perylene derivatives which are red luminescent material are mixed and used in a luminous layer 5.

LEGAL STATUS [Date of request for examination] 19.02.2001

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number] 3688207

[Date of registration] 17.06.2005

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

3.In the drawings, any words are not translated.

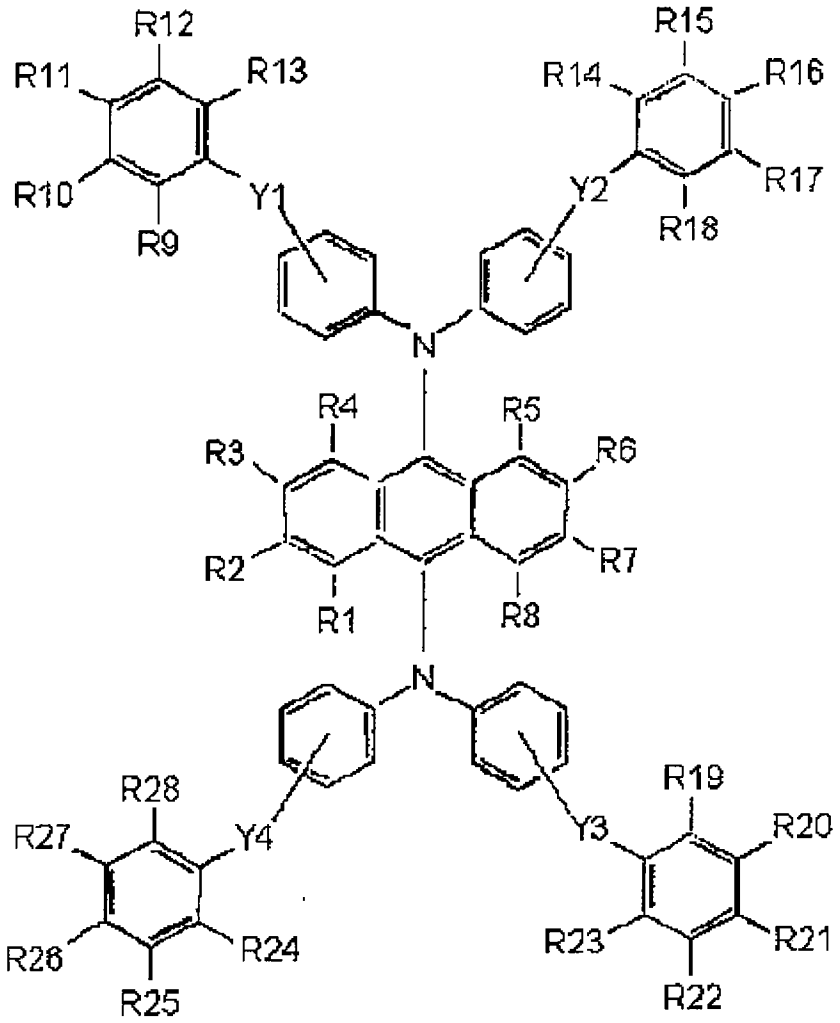
CLAIMS

[Claim(s)]

[Claim 1] It sets to the organic EL device equipped with the luminous layer which consists of a monolayer or an organic thin film of two or more layers at least between the anode plate which counters mutually, and cathode, and is the following general formula [1].

[Formula 1]

一般式［１］

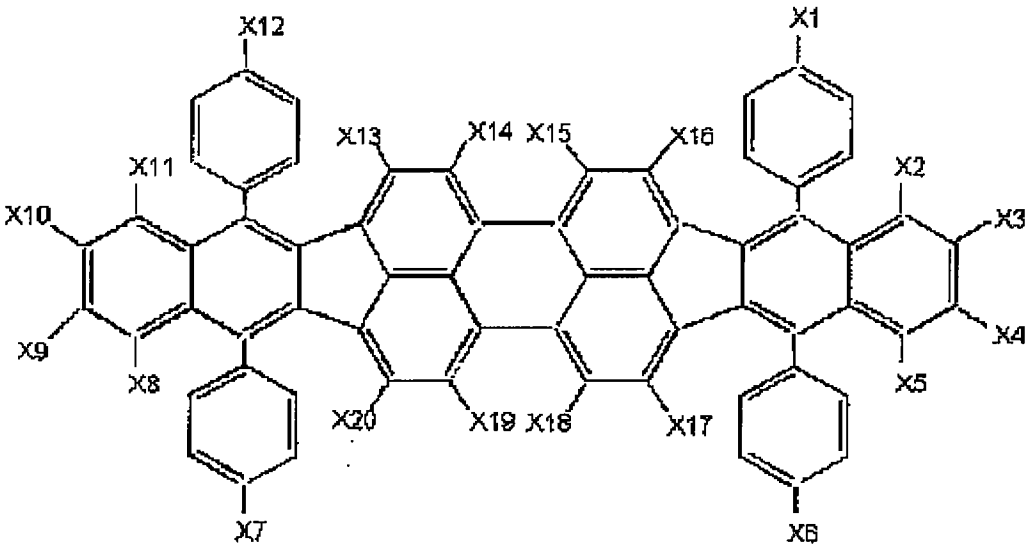


R1-R28 in [general formula [1] express independently the amino group which is not permuted [the aryl group which is not permuted / the alkoxy group which is not permuted / the alkyl group which is not permuted / a hydrogen atom, a halogen atom, a permutation, or /, a permutation, or /, a permutation, or /, a permutation, or], respectively. Y1-Y4 express independently the alkylene group which is not permuted [O, S, SO2, C=O, CH2O, CH2OCH2, a permutation, or],

respectively. It may join together mutually and R1-R4, and R5-R8 may form the five-membered ring of saturation or partial saturation, or six membered-rings.] The aromatic amine derivative come out of and shown, and the following general formula [2]

[Formula 2]

一般式［２］



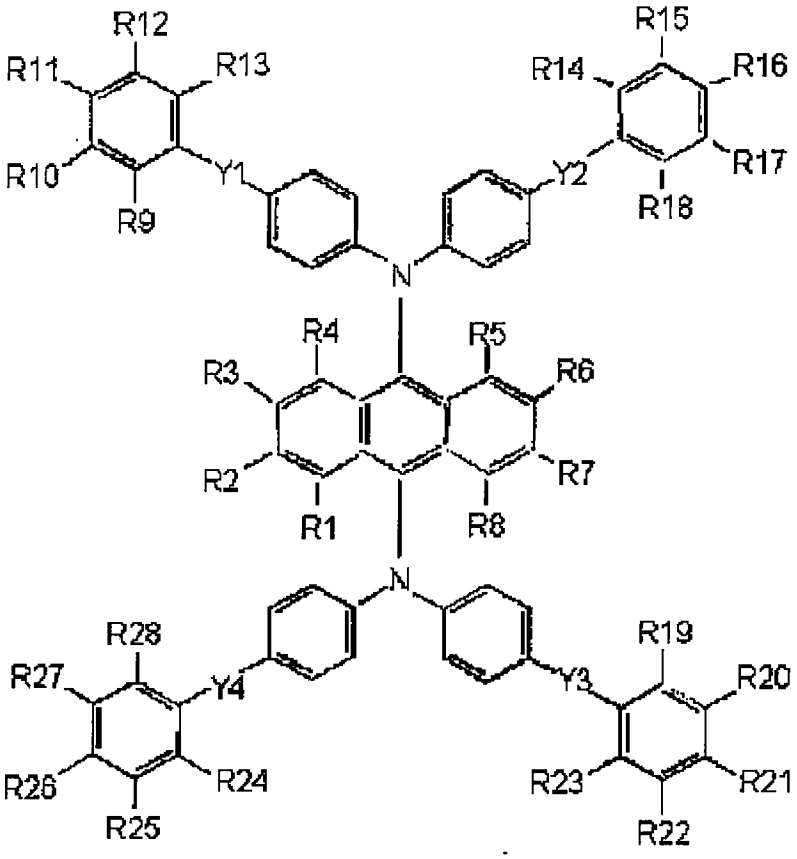
X1-X20 in [general formula [2] express independently the amino group which is not permuted [the aryl group which is not permuted / the alkoxy group which is not permuted / the alkyl group which is not permuted / a hydrogen atom, a halogen atom, a permutation, or /, a permutation, or /, a permutation, or /, a permutation, or], respectively. It may join together mutually and X1-X20 may form the five-membered ring of saturation or partial saturation, or six membered-rings.] The organic EL device characterized by having the luminous

layer of at least one layer which it came out [luminous layer] and mixed the dibenzo {[f, f']-4, 4', 7, and 7'-tetrapod phenyl} Jean Dino [1, 2, 3-cd:1', 2', 3'-lm] perylene derivative shown.

[Claim 2] It sets to the organic EL device equipped with the luminous layer which consists of a monolayer or an organic thin film of two or more layers at least between the anode plate which counters mutually, and cathode, and is the following general formula [4].

[Formula 3]

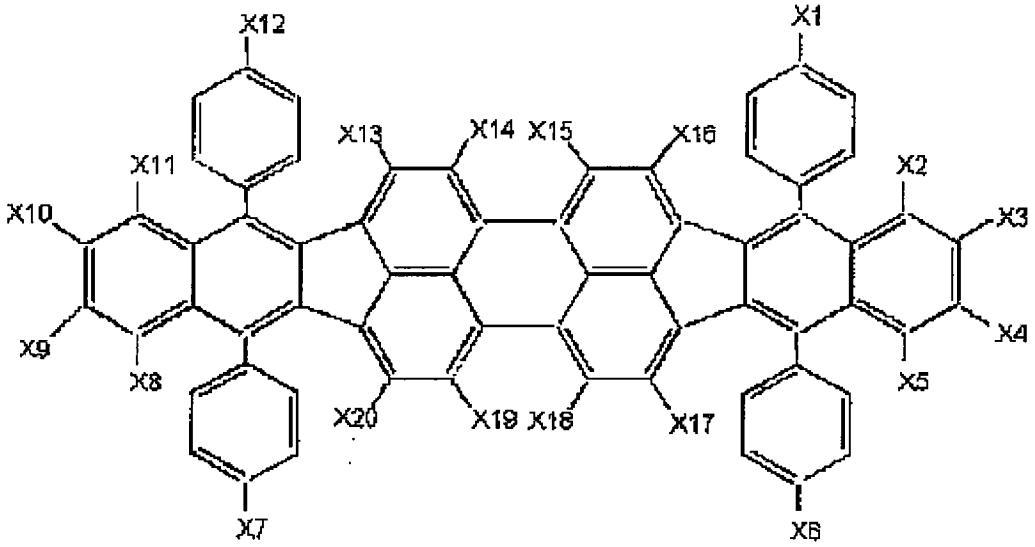
一般式［４］



R1-R28 in [general formula [4] express independently the amino group which is not permuted [the aryl group which is not permuted / the alkoxy group which is not permuted / the alkyl group which is not permuted / a hydrogen atom, a halogen atom, a permutation, or /, a permutation, or /, a permutation, or /, a permutation, or], respectively. Y1-Y4 express independently the alkylene group which is not permuted [O, S, SO2, C=O, CH2O, CH2OCH2, a permutation, or], respectively. It may join together mutually and R1-R4, and R5-R8 may form the five-membered ring of saturation or partial saturation, or six membered-rings.] The aromatic amine derivative come out of and shown, and the following general formula [2]

[Formula 4]

一般式［２］



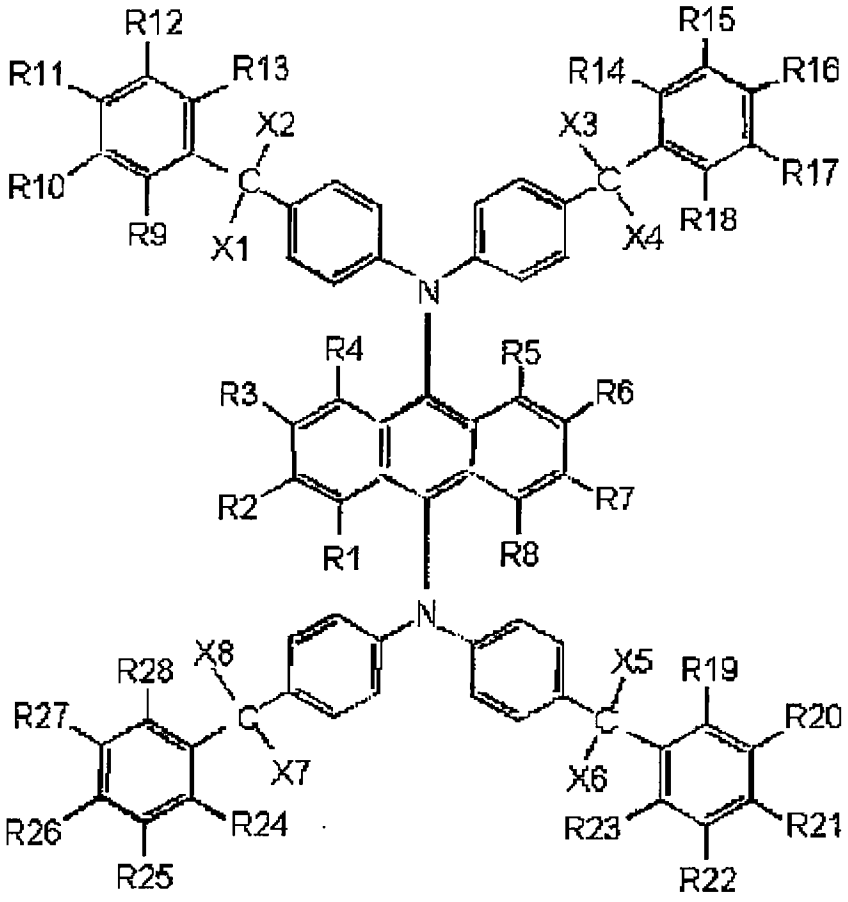
X1-X20 in [general formula [2] express independently the amino group which is

not permuted [the aryl group which is not permuted / the alkoxy group which is not permuted / the alkyl group which is not permuted / a hydrogen atom, a halogen atom, a permutation, or /, a permutation, or /, a permutation, or /, a permutation, or], respectively. It may join together mutually and X1-X20 may form the five-membered ring of saturation or partial saturation, or six membered-rings.] The organic EL device characterized by having the luminous layer of at least one layer which it came out [luminous layer] and mixed the dibenzo {[f, f']-4, 4', 7, and 7'-tetrapod phenyl} Jean Dino [1, 2, 3-cd:1', 2', 3'-lm] perylene derivative shown.

[Claim 3] It sets to the organic EL device equipped with the luminous layer which consists of a monolayer or an organic thin film of two or more layers at least between the anode plate which counters mutually, and cathode, and is the following general formula [5].

[Formula 5]

一般式［５］

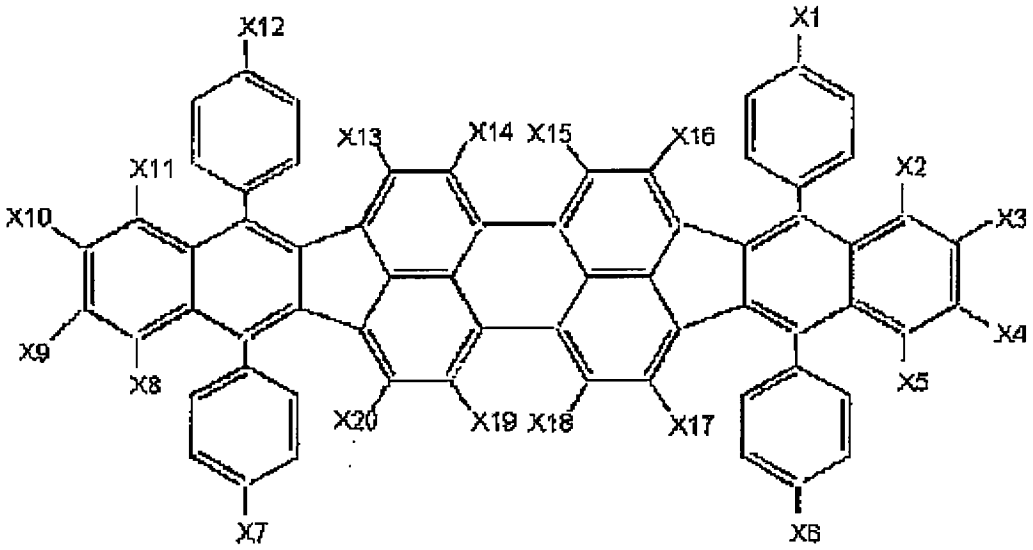


R1-R28 in [general formula [5] express independently the amino group which is not permuted [the aryl group which is not permuted / the alkoxy group which is not permuted / the alkyl group which is not permuted / a hydrogen atom, a halogen atom, a permutation, or /, a permutation, or /, a permutation, or /, a permutation, or], respectively. X1-X8 express the aryl group of the carbon numbers 6-16 which are not permuted [the alkyl group of the carbon numbers 1-20 which are not permuted / a permutation or /, a permutation, or]. It may join together mutually and R1-R4, and R5-R8 may form the five-membered ring of

saturation or partial saturation, or six membered-rings.] The aromatic amine derivative come out of and shown, and the following general formula [2]

[Formula 6]

一般式［２］



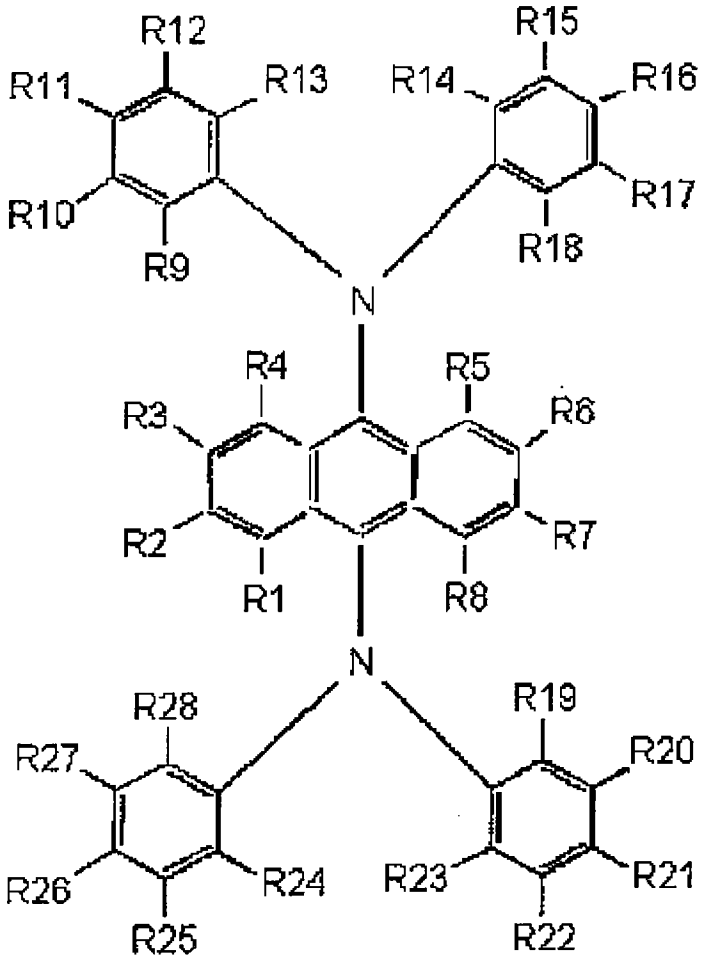
X1-X20 in [general formula [2] express independently the amino group which is not permuted [the aryl group which is not permuted / the alkoxy group which is not permuted / the alkyl group which is not permuted / a hydrogen atom, a halogen atom, a permutation, or /, a permutation, or /, a permutation, or /, a permutation, or], respectively. It may join together mutually and X1-X20 may form the five-membered ring of saturation or partial saturation, or six membered-rings.] The organic EL device characterized by having the luminous layer of at least one layer which it came out [luminous layer] and mixed the dibenzo {[f, f']-4, 4', 7, and 7'-tetrapod phenyl} Jean Dino [1, 2, 3-cd:1', 2', 3'-lm]

perylene derivative shown.

[Claim 4] It sets to the organic EL device equipped with the luminous layer which consists of a monolayer or an organic thin film of two or more layers at least between the anode plate which counters mutually, and cathode, and is the following general formula [6].

[Formula 7]

一般式［６］

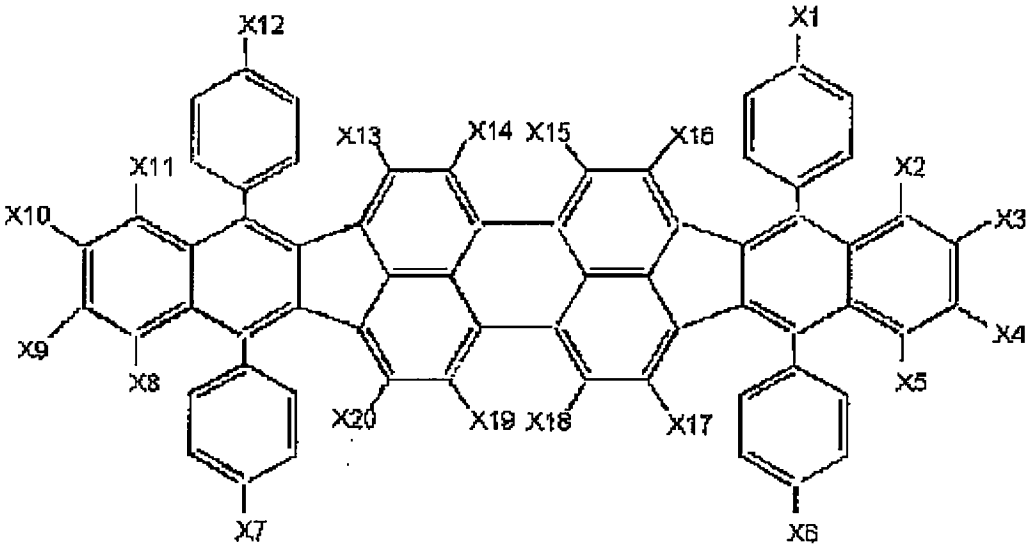


R1-R28 in [general formula [6] express independently the amino group which is

not permuted [the aryl group which is not permuted / the alkoxy group which is not permuted / the alkyl group which is not permuted / a hydrogen atom, a halogen atom, a permutation, or /, a permutation, or /, a permutation, or /, a permutation, or], respectively. It may join together mutually and R1-R4, and R5-R8 may form the five-membered ring of saturation or partial saturation, or six membered-rings.] The aromatic amine derivative come out of and shown, and the following general formula [2]

[Formula 8]

一般式［２］



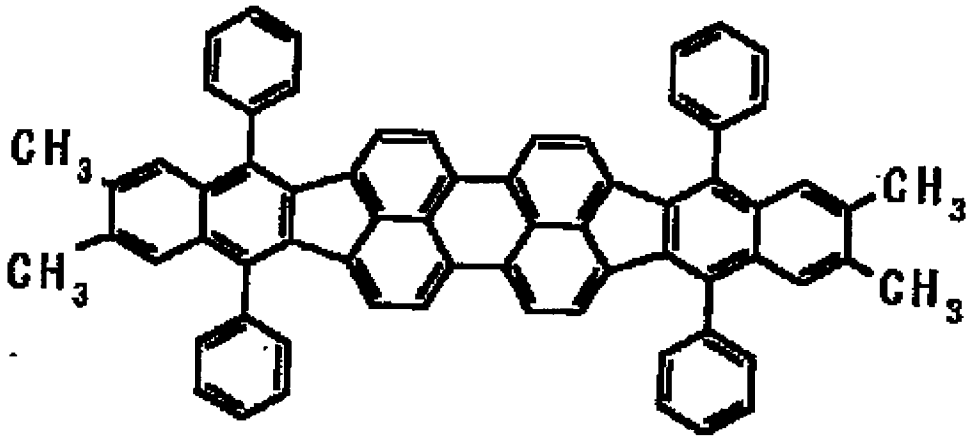
X1-X20 in [general formula [2] express independently the amino group which is not permuted [the aryl group which is not permuted / the alkoxy group which is not permuted / the alkyl group which is not permuted / a hydrogen atom, a halogen atom, a permutation, or /, a permutation, or /, a permutation, or /, a

permutation, or], respectively. It may join together mutually and X1-X20 may form the five-membered ring of saturation or partial saturation, or six membered-rings.] The organic EL device characterized by having the luminous layer of at least one layer which it came out [luminous layer] and mixed the dibenzo {[f, f']-4, 4', 7, and 7'-tetrapod phenyl} Jean Dino [1, 2, 3-cd:1', 2', 3'-lm] perylene derivative shown.

[Claim 5] An organic EL device given in any 1 term of claims 1-4 characterized by being the compound in which the dibenzo {[f, f']-4, 4', 7, and 7'-tetrapod phenyl} Jean Dino [1, 2, 3-cd:1', 2', 3'-lm] perylene derivative of a general formula [2] is shown by the following formula [2a].

[Formula 9]

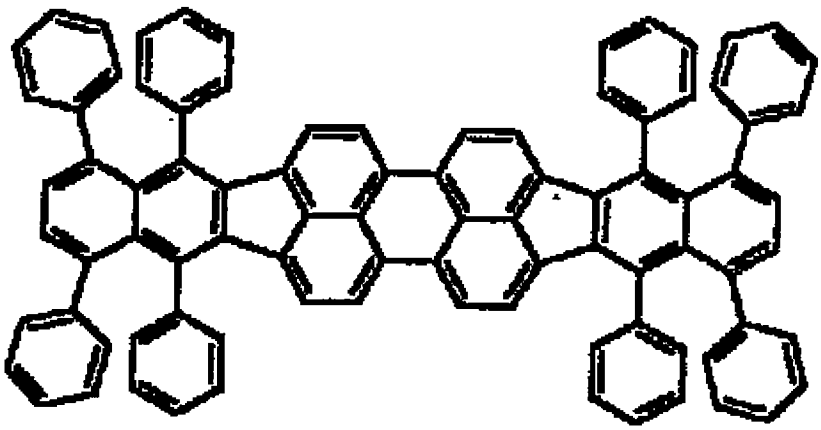
式 [2 a]



[Claim 6] An organic EL device given in any 1 term of claims 1-4 characterized by being the compound in which the dibenzo {[f, f']-4, 4', 7, and 7'-tetrapod phenyl} Jean Dino [1, 2, 3-cd:1', 2', 3'-lm] perylene derivative of a general formula [2] is shown by the following formula [2b].

[Formula 10]

式 [2 b]



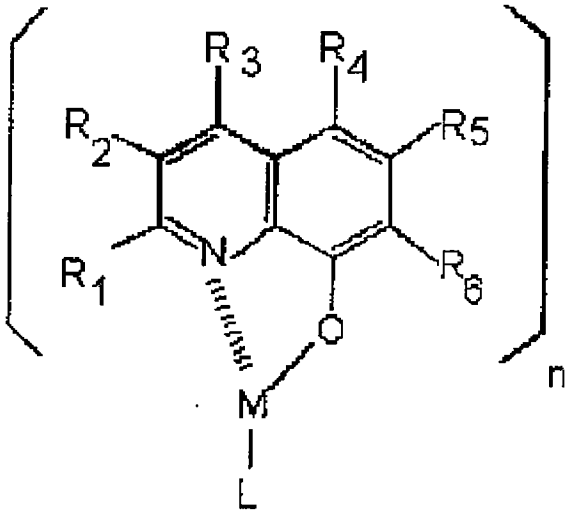
[Claim 7] The aromatic amine derivative of a general formula [1], [4], [5], or [6] is made into a host. The dibenzo {[f, f']-4, 4', 7, and 7'-tetrapod phenyl} Jean Dino [1, 2, 3-cd:1', 2', 3'-lm] perylene derivative of a general formula [2] is doped by this. An organic EL device given in any 1 term of claims 1-6 characterized by a dope ratio being 1 - 10%.

[Claim 8] An electronic injection layer or an electron transport layer is the

following general formula [3].

[Formula 11]

一般式［３］



M in [general formula [3] expresses a metal atom. R1-R6 express independently the cycloalkyl radical or cyano group which is not permuted [the aryloxy group which is not permuted / the aryl group which is not permuted / the alkoxy group which is not permuted / the alkyl group which is not permuted / a hydrogen atom, a halogen atom, a permutation, or /, a permutation, or /, a permutation, or /, a permutation, or /, a permutation, or], respectively. L expresses the ligand which has the cycloalkyl radical which is not permuted [the aryloxy group which is not permuted / the alkyl group which is not permuted / the aryloxy group which is not permuted / the alkoxy group which is not permuted / a halogen atom, a permutation, or /, a permutation, or /, a permutation, or /, a permutation, or /, a

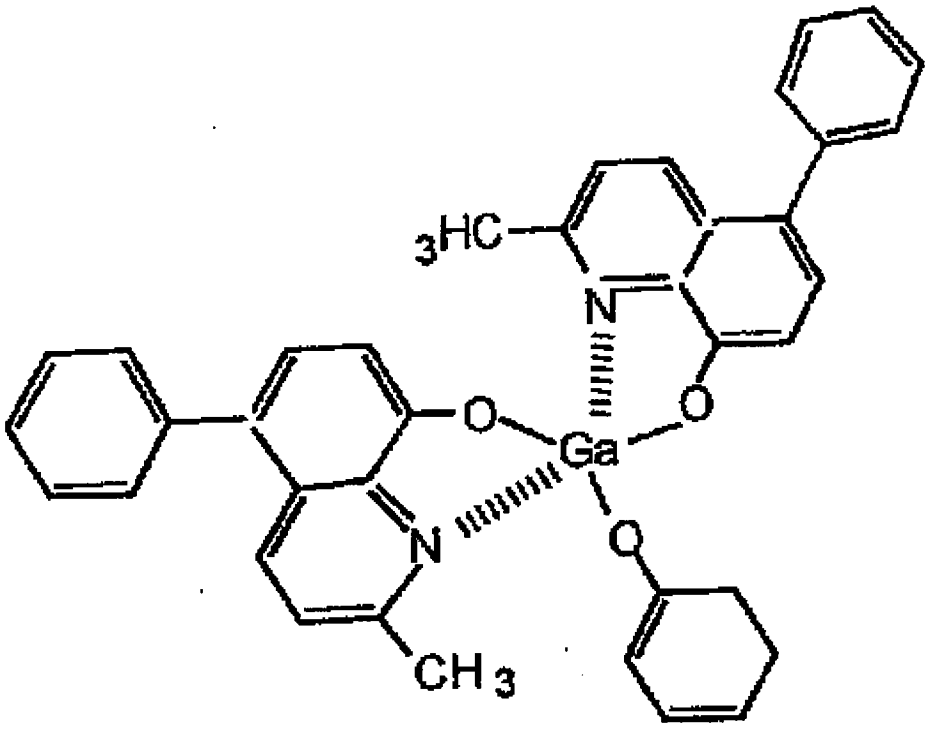
permutation, or].] An organic EL device given in any 1 term of claims 1-7 characterized by coming out and including the organometallic complex shown.

[Claim 9] The organic EL device according to claim 8 characterized by R4 being an aryl group in the organometallic complex of a general formula [3].

[Claim 10] The organic EL device according to claim 9 characterized by the organometallic complex of a general formula [3] being the compound shown by the following formula [3a].

[Formula 12]

式 [3 a]

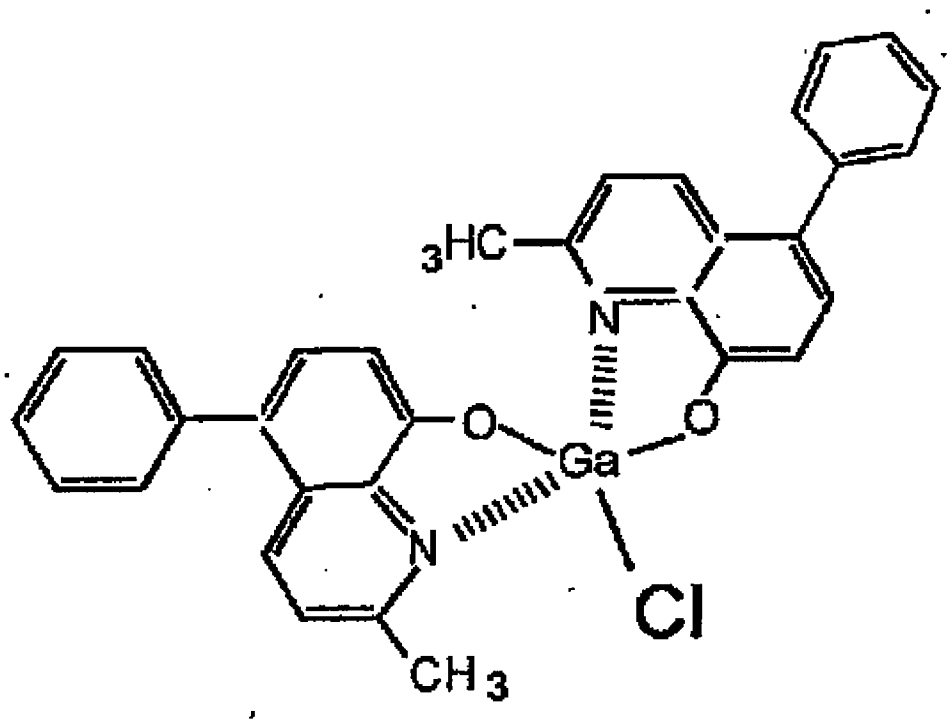


[Claim 11] The organic EL device according to claim 9 characterized by the

organometallic complex of a general formula [3] being the compound shown by the following formula [3b].

[Formula 13]

式 [3 b]



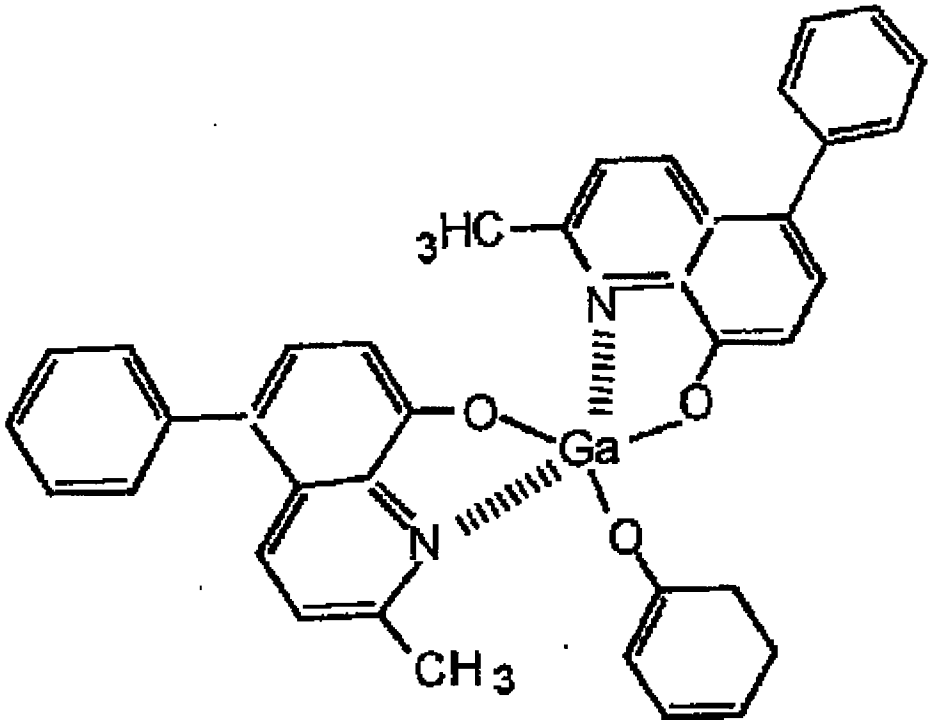
[Claim 12] An organic EL device given in any 1 term of claims 8-11 characterized by an electronic injection layer or an electron transport layer containing two or more sorts of organometallic complexes shown by the general formula [3].

[Claim 13] The organic EL device according to claim 12 characterized by an electronic injection layer or an electron transport layer containing the compound shown by the compound shown by the following formula [3a], and the following

formula [3b].

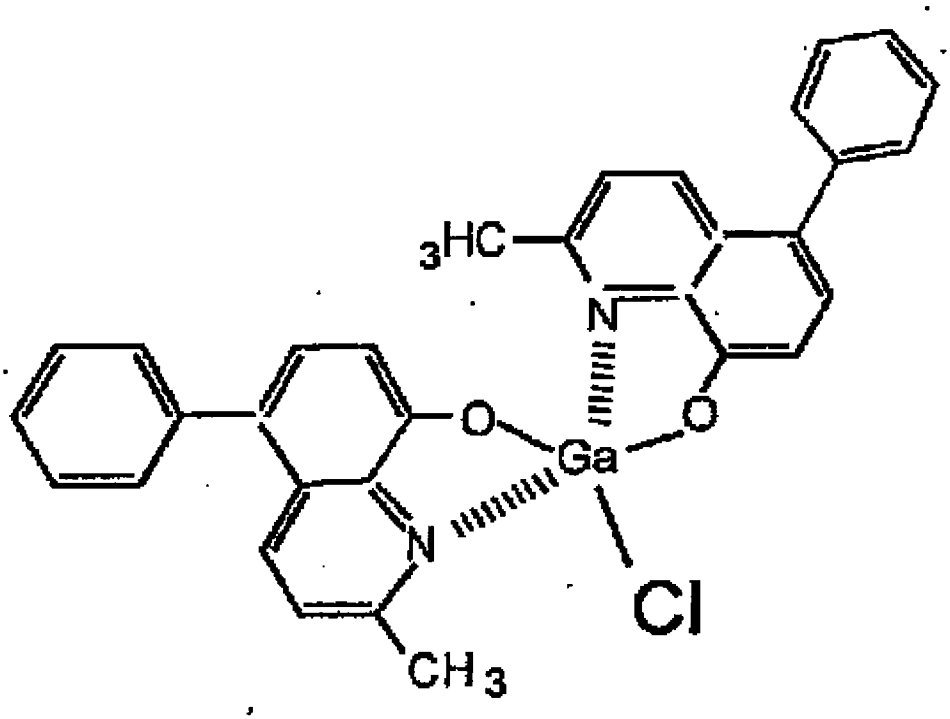
[Formula 14]

式［３ａ］



[Formula 15]

式 [3 b]



[Claim 14] An electronic injection layer or an electron transport layer is the following general formula [a].

(Q) 3-aluminum -- [a]

Q in [general formula [a] expresses 8-quinolate ligand which is not permuted [a permutation or].] An organic EL device given in any 1 term of claims 1-13 characterized by coming out and including the luminescent organic aluminium complex shown.

[Claim 15] The organic electroluminescence display characterized by carrying the organic EL device of a publication in any 1 term of claims 1-14.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] When this invention is further explained in full detail about an organic EL device (organic electroluminescent element), it is excellent in luminous efficiency and relates to the organic electroluminescence display using a red organic EL device and it with good brightness and chromaticity.

[0002]

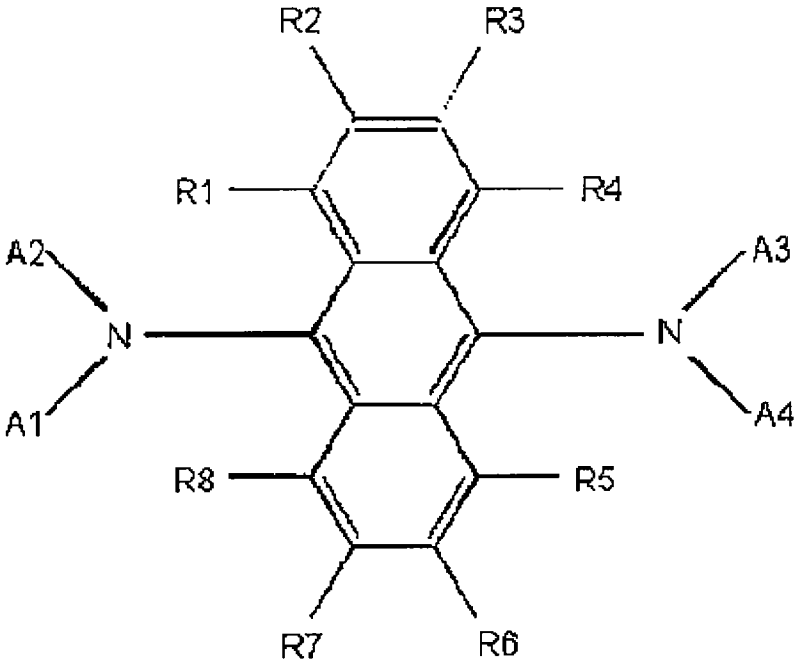
[Description of the Prior Art] The following general formula with the fluorescence quantum yield high in order to obtain the brightness of practical use level in an organic EL device, especially a red organic EL device conventionally currently generally used [a]

(Q) 3-aluminum -- [a]

Q in [general formula [a] expresses 8-quinolate ligand which is not permuted [a permutation or].] A ******** organic aluminium complex and the following general formula [b]

[Formula 16]

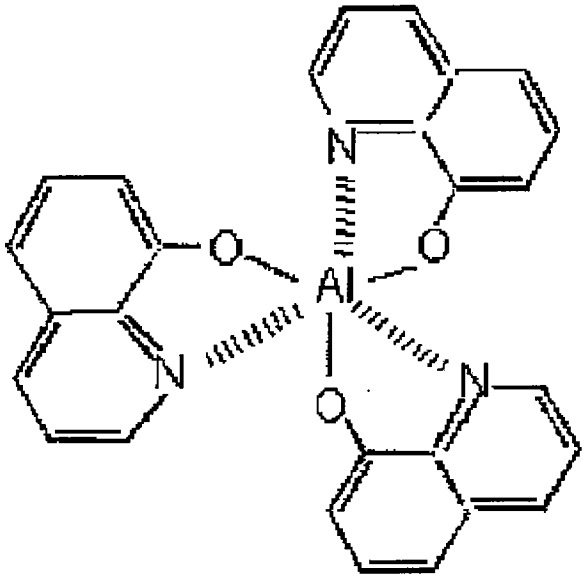
一般式［b］



A1 in [general formula [b] - A4 express the aryl group of carbon numbers 6-18 independently, respectively. R1-R8 express a hydrogen atom, a halogen atom, an alkyl group, an alkoxy group, an aryl group, or the amino group independently, respectively.] The ********** derivative was made into the host and what doped the red ingredient to this was made into the luminous layer.

[0003] for example, C.W.Tang: "An Overview of Organic Electroluminescent Materialsand Devices" and SID -- the following compound 4 which is a luminescent organic aluminium complex in an organic EL device given in 96DIGEST., 14.1, and pp.181-184 (1996) -- [Formula 17]

化合物 4



** tris (8-quinolate) aluminum is made into a host, and it is considering as the luminous layer by doping DCJT of red luminescent material to this. Moreover, in JP,10-72581,A, the aromatic amine derivative shown in said general formula [b] is made into a host, and it is considering as the luminous layer by doping red luminescent material to this.

[0004] By the way, from a practical viewpoint, the present organic EL device has reinforcement and indispensable thermal stability, therefore was using the hole impregnation layer for the raise in a heatproof between the anode plate and the hole transportation layer. However, while the life property improved by this, the hole impregnation property to a luminous layer was getting worse. Consequently, the recombination yield in a luminous layer fell and sufficient luminous efficiency

was not acquired. Furthermore, there was a problem that change, the problem, i.e., the carrier balance, that an electron leaks from a luminous layer by relation of applied voltage, and a tint changed when the hole transportation layer itself emits light.

[0005] Here, it explains, referring to a drawing about the conventional organic EL device. Drawing 5 is the sectional view of an organic EL device. In drawing 5 , the conventional organic EL device is constituted by forming the anode plate (transparent electrode) 2 which consists of ITO (indium-stannic-acid ghost) on a glass substrate 1, and forming an organic electroluminescence layer and cathode 7 grades, such as the hole impregnation layer 3, the hole transportation layer 4, a luminous layer 5, and an electron transport layer 6, on this. A luminescent organic aluminium complex with a high fluorescence quantum yield (general formula [a]) is made into a host here at a luminous layer 5, and the red ingredient is doped by this. Moreover, the luminescent organic aluminium complex (general formula [a]) which has electronic transportability as an electron transport layer 6 at this time may be used.

[0006]

[Problem(s) to be Solved by the Invention] Since the hole impregnation layer for the raise in a heatproof was used conventionally, while the life property improved, the hole impregnation property to a luminous layer was getting worse. This

caused decline in the recombination yield of the hole-electron in a luminous layer, and had caused the problem that sufficient luminous efficiency was not acquired. Furthermore, an electron began to leak from a luminous layer with the increment in an electrical potential difference, and when the hole transportation layer itself emitted light, there was also a problem that a tint changed. Therefore, with the conventional component configuration, it excelled in luminous efficiency and the organic electroluminescence device whose chromaticity is high brightness and was always stable was not able to be offered. The recombination of the hole-electron which electronic transportability should change if this has a low hole impregnation property to a luminous layer and an electrical potential difference increases, and should occur by the luminous layer essentially was because it occurs in a hole transportation layer.

[0007] This invention was made in view of the situation mentioned above, is excellent in luminous efficiency, and aims at offering a red organic EL device with good brightness and chromaticity.

[0008]

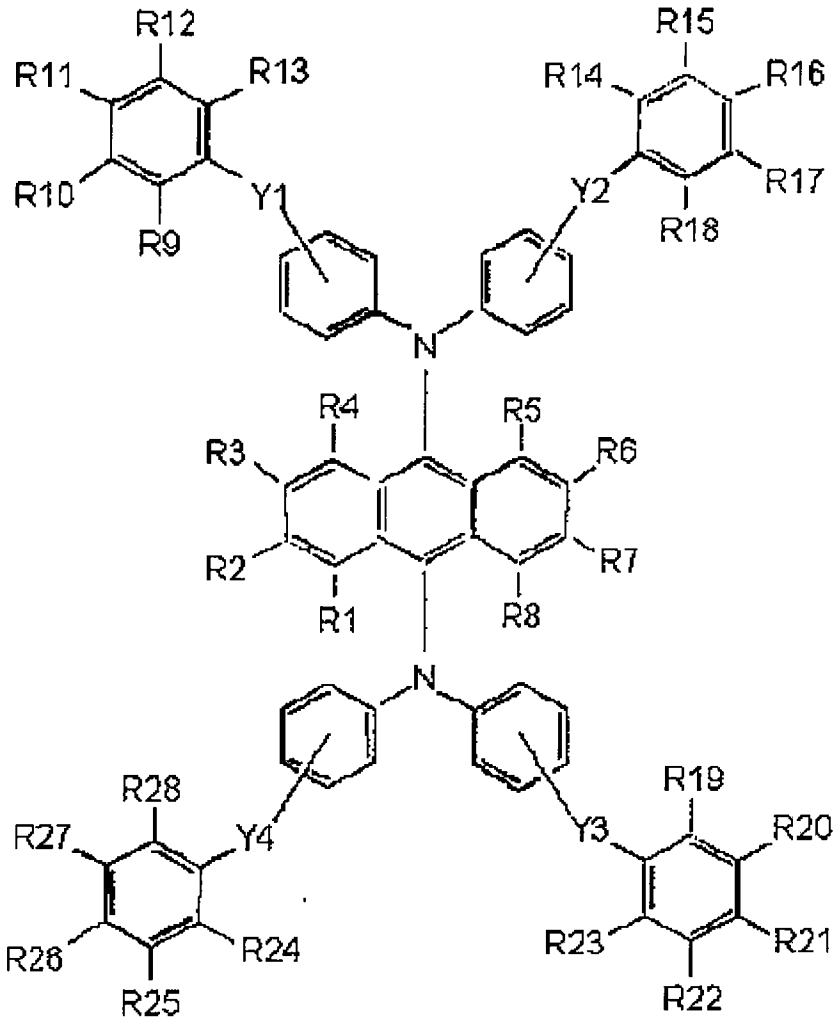
[Means for Solving the Problem] This invention offers the organic EL device and organic electroluminescence display which are shown in following the (1) - (15) in order to attain said purpose.

[0009] (1) Set to the organic EL device equipped with the luminous layer which

consists of a monolayer or an organic thin film of two or more layers at least between the anode plate which counters mutually, and cathode, and it is the following general formula [1].

[Formula 18]

一般式［１］

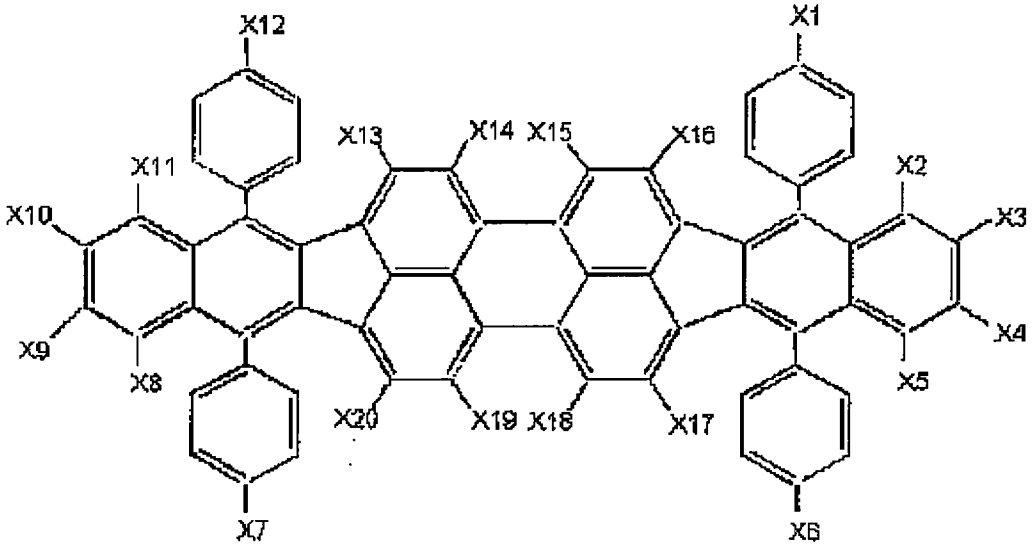


R1-R28 in [general formula [1] express independently the amino group which is not permuted [the aryl group which is not permuted / the alkoxy group which is

not permuted / the alkyl group which is not permuted / a hydrogen atom, a halogen atom, a permutation, or /, a permutation, or /, a permutation, or /, a permutation, or], respectively. Y1-Y4 express independently the alkylene group which is not permuted [O, S, SO2, C=O, CH2O, CH2OCH2, a permutation, or], respectively. It may join together mutually and R1-R4, and R5-R8 may form the five-membered ring of saturation or partial saturation, or six membered-rings.] The aromatic amine derivative come out of and shown, and the following general formula [2]

[Formula 19]

一般式［２］



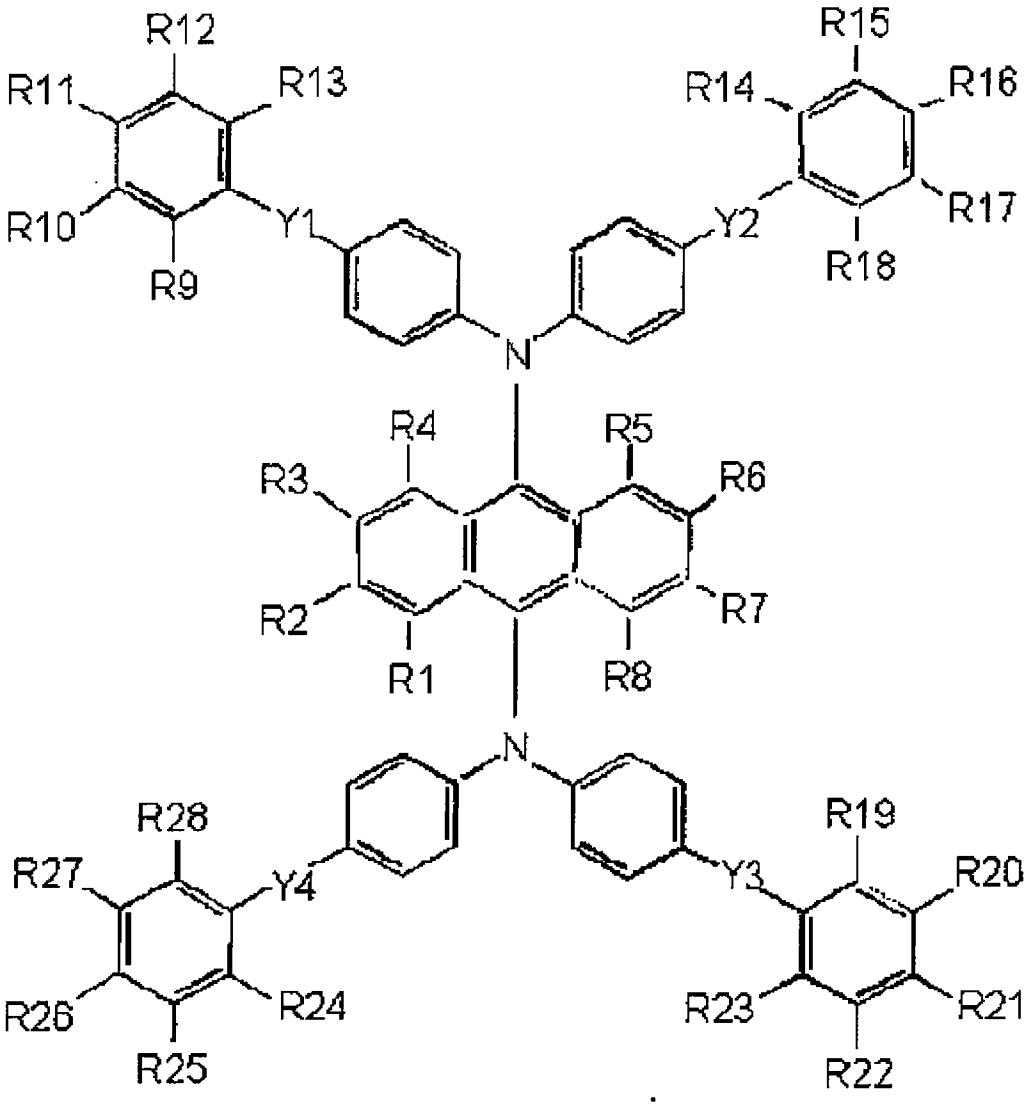
X1-X20 in [general formula [2] express independently the amino group which is not permuted [the aryl group which is not permuted / the alkoxy group which is not permuted / the alkyl group which is not permuted / a hydrogen atom, a

halogen atom, a permutation, or /, a permutation, or /, a permutation, or /, a permutation, or], respectively. It may join together mutually and X1-X20 may form the five-membered ring of saturation or partial saturation, or six membered-rings.] The organic EL device characterized by having the luminous layer of at least one layer which it came out [luminous layer] and mixed the dibenzo {[f, f']-4, 4', 7, and 7'-tetrapod phenyl} Jean Dino [1, 2, 3-cd:1', 2', 3'-lm] perylene derivative shown.

[0010] (2) Set to the organic EL device equipped with the luminous layer which consists of a monolayer or an organic thin film of two or more layers at least between the anode plate which counters mutually, and cathode, and it is the following general formula [4].

[Formula 20]

一般式［４］



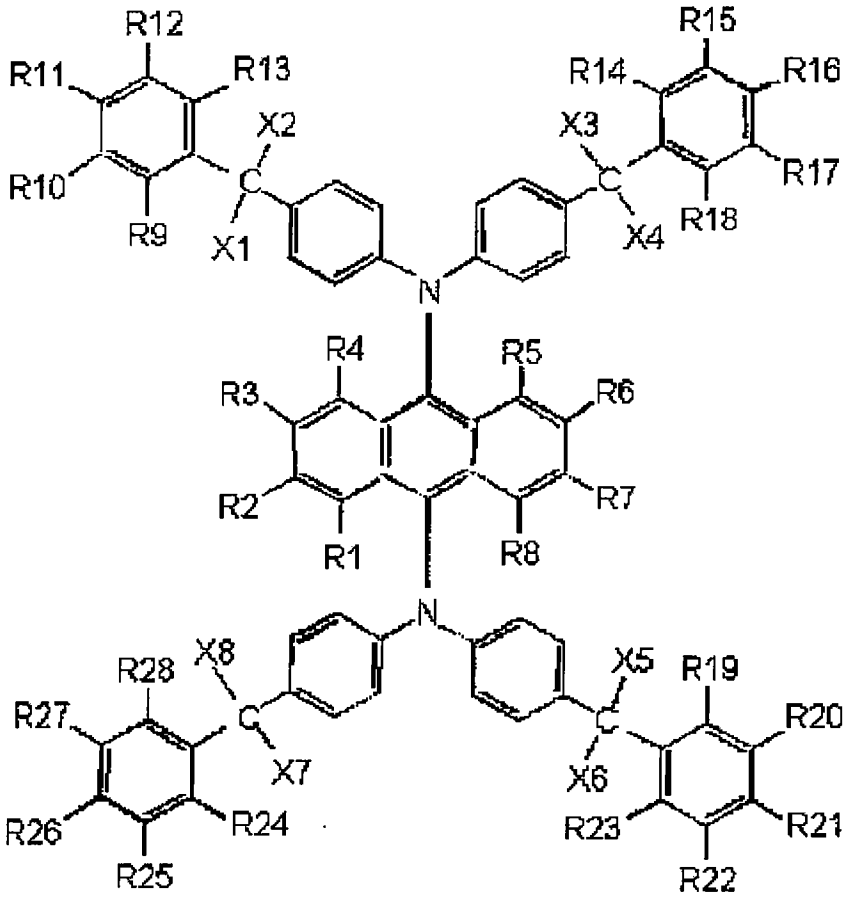
R1-R28 in [general formula [4] express independently the amino group which is not permuted [the aryl group which is not permuted / the alkoxy group which is not permuted / the alkyl group which is not permuted / a hydrogen atom, a halogen atom, a permutation, or /, a permutation, or /, a permutation, or /, a permutation, or], respectively. Y1-Y4 express independently the alkylene group

which is not permuted [O, S, SO2, C=O, CH2O, CH2OCH2, a permutation, or], respectively. It may join together mutually and R1-R4, and R5-R8 may form the five-membered ring of saturation or partial saturation, or six membered-rings.] The organic EL device characterized by having the luminous layer of at least one layer which it came out [luminous layer] and mixed the aromatic amine derivative shown and the dibenzo {[f, f']-4, 4', 7, and 7'-tetrapod phenyl} Jean Dino [1, 2, 3-cd:1', 2', 3'-lm] perylene derivative shown by said general formula [2].

[0011] (3) Set to the organic EL device equipped with the luminous layer which consists of a monolayer or an organic thin film of two or more layers at least between the anode plate which counters mutually, and cathode, and it is the following general formula [5].

[Formula 21]

一般式［５］



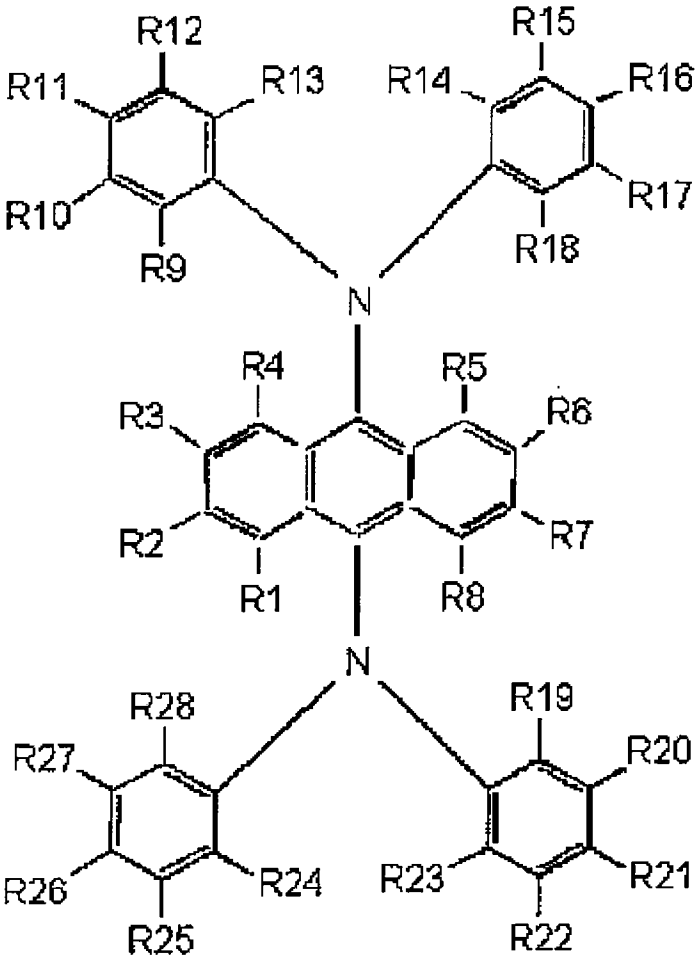
R1-R28 in [general formula [5] express independently the amino group which is not permuted [the aryl group which is not permuted / the alkoxy group which is not permuted / the alkyl group which is not permuted / a hydrogen atom, a halogen atom, a permutation, or /, a permutation, or /, a permutation, or /, a permutation, or], respectively. X1-X8 express the aryl group of the carbon numbers 6-16 which are not permuted [the alkyl group of the carbon numbers 1-20 which are not permuted / a permutation or /, a permutation, or]. It may join together mutually and R1-R4, and R5-R8 may form the five-membered ring of

saturation or partial saturation, or six membered-rings.] The organic EL device characterized by having the luminous layer of at least one layer which it came out [luminous layer] and mixed the aromatic amine derivative shown and the dibenzo {[f, f']-4, 4', 7, and 7'-tetrapod phenyl} Jean Dino [1, 2, 3-cd:1', 2', 3'-lm] perylene derivative shown by said general formula [2].

[0012] (4) Set to the organic EL device equipped with the luminous layer which consists of a monolayer or an organic thin film of two or more layers at least between the anode plate which counters mutually, and cathode, and it is the following general formula [6].

[Formula 22]

一般式［６］



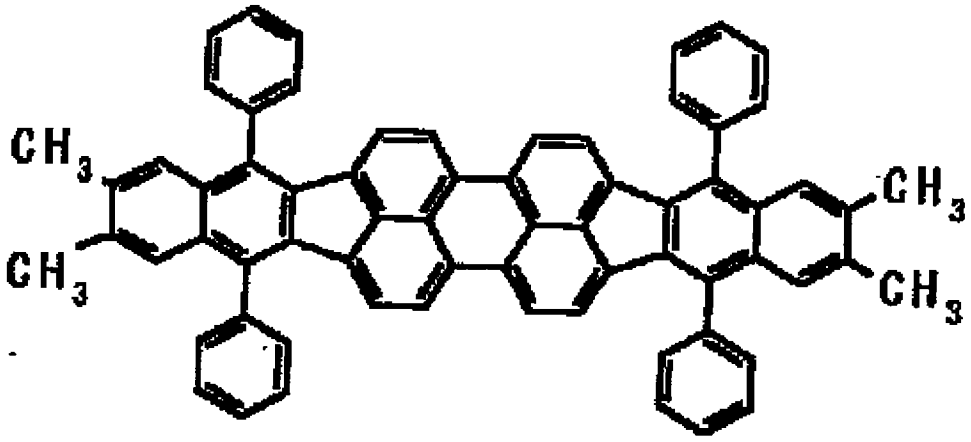
R1-R28 in [general formula [6] express independently the amino group which is not permuted [the aryl group which is not permuted / the alkoxy group which is not permuted / the alkyl group which is not permuted / a hydrogen atom, a halogen atom, a permutation, or /, a permutation, or /, a permutation, or /, a permutation, or], respectively. It may join together mutually and R1-R4, and R5-R8 may form the five-membered ring of saturation or partial saturation, or six membered-rings.] The organic EL device characterized by having the luminous

layer of at least one layer which it came out [luminous layer] and mixed the aromatic amine derivative shown and the dibenzo {[f, f']-4, 4', 7, and 7'-tetrapod phenyl} Jean Dino [1, 2, 3-cd:1', 2', 3'-lm] perylene derivative shown by said general formula [2].

[0013] (5) a general formula -- [-- two --] -- dibenzo one -- {-- [-- f -- f -- ' --] - four -- four -- ' -- seven -- seven -- ' - tetra--- phenyl --} -- the organic EL device of (1) - (4) characterized by being the compound in which a Jean Dino [1, 2, 3-cd:1', 2', 3'-lm] perylene derivative is shown by the following formula [2a].

[Formula 23]

式 [2 a]

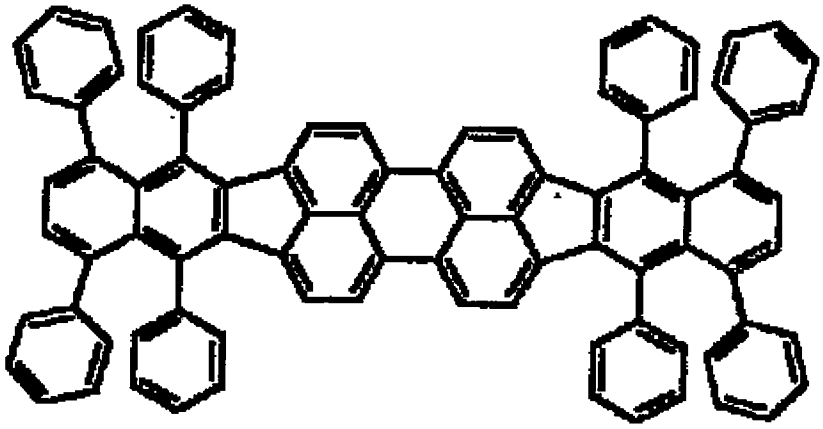


[0014] (6) a general formula -- [-- two --] -- dibenzo one -- {-- [-- f -- f -- ' --] - four -- four -- ' -- seven -- seven -- ' - tetra--- phenyl --} -- the organic EL device of (1) -

(4) characterized by being the compound in which a Jean Dino [1, 2, 3-cd:1', 2', 3'-lm] perylene derivative is shown by the following formula [2b].

[Formula 24]

式 [2 b]

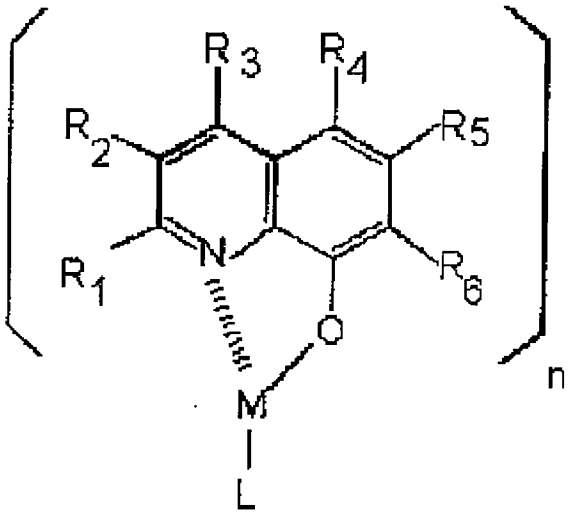


[0015] (7) Make the aromatic amine derivative of a general formula [1], [4], [5], or [6] into a host. The dibenzo {[f, f']-4, 4', 7, and 7'-tetrapod phenyl} Jean Dino [1, 2, 3-cd:1', 2', 3'-lm] perylene derivative of a general formula [2] is doped by this. The organic EL device of (1) - (6) characterized by a dope ratio being 1 - 10%.

[0016] (8) An electronic injection layer or an electron transport layer is the following general formula [3].

[Formula 25]

一般式［３］



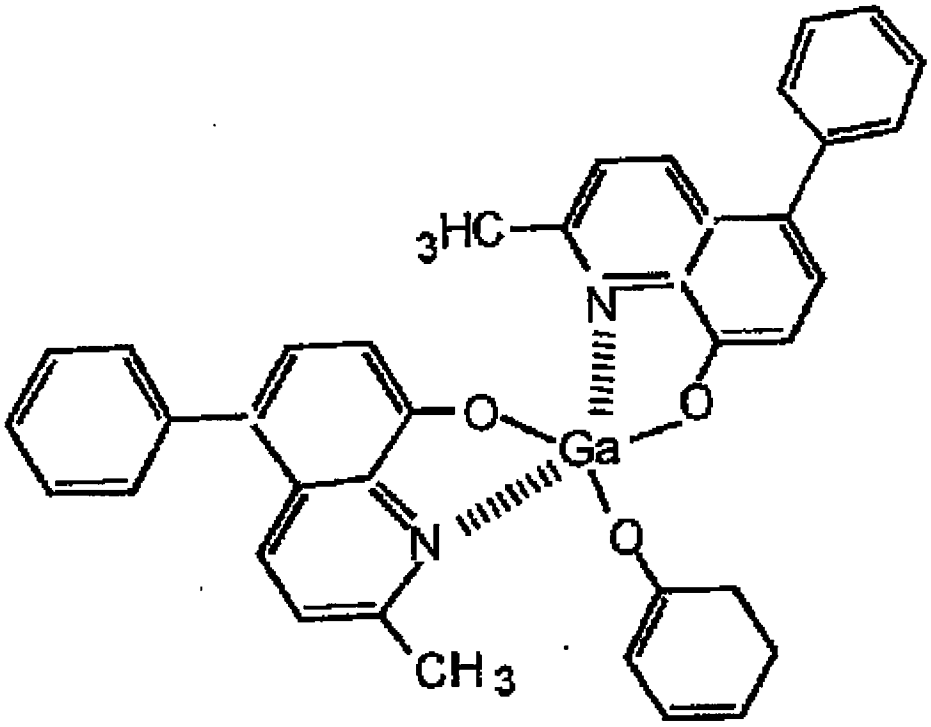
M in [general formula [3] expresses a metal atom. R1-R6 express independently the cycloalkyl radical or cyano group which is not permuted [the aryloxy group which is not permuted / the aryl group which is not permuted / the alkoxy group which is not permuted / the alkyl group which is not permuted / a hydrogen atom, a halogen atom, a permutation, or /, a permutation, or /, a permutation, or /, a permutation, or /, a permutation, or], respectively. L expresses the ligand which has the cycloalkyl radical which is not permuted [the aryloxy group which is not permuted / the alkyl group which is not permuted / the aryloxy group which is not permuted / the alkoxy group which is not permuted / a halogen atom, a permutation, or /, a permutation, or /, a permutation, or /, a permutation, or /, a permutation, or].] The organic EL device of (1) - (7) characterized by coming out and including the organometallic complex shown.

[0017] (9) The organic EL device of (8) characterized by R4 being an aryl group in the organometallic complex of a general formula [3].

[0018] (10) The organic EL device of (9) characterized by the organometallic complex of a general formula [3] being the compound shown by the following formula [3a].

[Formula 26]

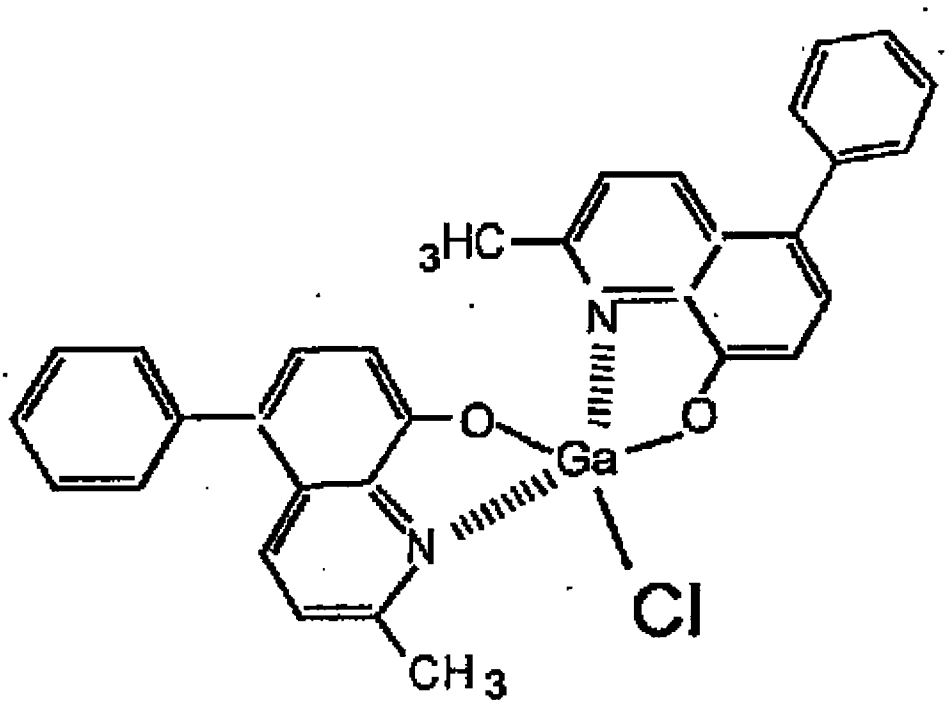
式 [3 a]



[0019] (11) The organic EL device of (9) characterized by the organometallic complex of a general formula [3] being the compound shown by the following formula [3b].

[Formula 27]

式［３ｂ］



[0020] (12) The organic EL device of (8) - (11) characterized by an electronic injection layer or an electron transport layer containing two or more sorts of organometallic complexes shown by the general formula [3].

[0021] (13) The organic EL device of (12) characterized by an electronic injection layer or an electron transport layer containing the compound shown by the compound shown by said formula [3a], and said formula [3b].

[0022] (14) An electronic injection layer or an electron transport layer is the following general formula [a].

(Q) 3-aluminum -- [a]

Q in [general formula [a] expresses 8-quinolate ligand which is not permuted [a permutation or].] The organic EL device of (1) - (13) characterized by coming out and including the luminescent organic aluminium complex shown.

[0023] (15) The above (1) Organic electroluminescence display characterized by carrying the organic EL device of - (14).

[0024] The aromatic amine derivative in which this invention is shown by the general formula [1], [4], [5], and [6] in a luminous layer, By mixing the dibenzo {[f, f']-4, 4', 7, and 7'-tetrapod phenyl} Jean Dino [1, 2, 3-cd:1', 2', 3'-lm] perylene derivative of the red luminescent material shown by the general formula [2] Giving better hole transportability ability (electronic block engine performance), concentration quenching of red luminescent material, etc. can be made to control moderately, consequently it excels in luminous efficiency, and a red organic EL device with good brightness and chromaticity can be obtained.

[0025] Moreover, improvement in a life property can be further aimed at also from using said aromatic amine derivative which has a long lasting property as a green luminescent material, and said dibenzo {[f, f']-4, 4', 7, and 7'-tetrapod phenyl} Jean Dino [1, 2, 3-cd:1', 2', 3'-lm] perylene derivative of an amorphous ingredient.

[0026] Furthermore, if two or more sorts of organometallic complexes shown in

an electronic injection layer or an electron transport layer by the general formula [3] are made to contain, brightness can be held highly. That is, when one kind of above-mentioned organometallic complex is used in an electronic injection layer or an electron transport layer, if long duration use is carried out under an elevated temperature, condensation and crystallization of a thin film will advance, and there is an inclination for an electron injection property or electronic transport properties to fall. On the other hand, since amorphous nature (amorphous nature) will become high if two or more kinds of above-mentioned organometallic complexes are made to contain, even if it uses it for a long time, it is hard to produce condensation and crystallization, therefore the fall of an electron injection property or electronic transport properties can be controlled.

[0027]

[Embodiment of the Invention] Next, the operation gestalt of this invention is explained to a detail with reference to a drawing. Drawing 1 is the outline sectional view of the organic EL device in which 1 operation gestalt of this invention is shown. In drawing 1 , this organic EL device is constituted by forming the anode plate (transparent electrode) 2 which consists of ITO (indium-stannic-acid ghost) on a glass substrate 1, and forming an organic electroluminescence layer and cathode 7 grades, such as the hole impregnation layer 3, the hole transportation layer 4, a luminous layer 5, and an electron

transport layer 6, on this. In order to give thermal resistance to a component, the hole impregnation layer for the raise in a heatproof is prepared as a hole impregnation layer 3.

[0028] Here, it is used, mixing the aromatic amine derivative of a general formula [1], and the dibenzo {[f, f']-4, 4', 7, and 7'-tetrapod phenyl} Jean Dino [1, 2, 3-cd:1', 2', 3'-lm] perylene derivative of the general formula [2] which is red luminescent material to a luminous layer 5 in the component of this invention. In order to control the amount of dopes of a dibenzo {[f, f']-4, 4', 7, and 7'-tetrapod phenyl} Jean Dino [1, 2, 3-cd:1', 2', 3'-lm] perylene derivative by the vacuum evaporationo rate and to control concentration quenching of coloring matter itself at this time, as for the amount of dopes, it is desirable to make it to about 1 - 10% to said aromatic amine derivative.

[0029] By the way, the compound shown by the general formula [1] of this invention is compoundable by the well-known approach. For example, it is compoundable by making the amine derivative which is not permuted [a permutation or], potassium carbonate, a sodium carbonate and a potassium hydroxide, a sodium hydroxide, etc. react to an anthracene derivative, an anthraquinone derivative, etc. under solvents, such as benzene, toluene, or a xylene. As a catalyst, there are copper powder, a cuprous chloride, tin, a stannous chloride, a pyridine, etc. Moreover, the compound shown by the

general formula [2] of this invention is also compoundable by the well-known approach. For example, it is compoundable by making [Benzok] fluoranthene derivative react under existence of an aluminum chloride/sodium chloride, cobalt fluoride, a trifluoroacetic acid thallium, etc.

[0030] Next, the hole block engine performance in an electron transport layer can be further enlarged by using the large organometallic complex of the ionization potential shown by the general formula [3] to an electron transport layer 6. The electronic transportation ingredient shown by the general formula [3] is compoundable by the well-known approach. For example, the compound which has the inside of the parenthesis of a gallium compound and a general formula [3] and the ligand residue of L is compoundable as a raw material. That is, the residue which has quinoline residue, such as 8-hydroxyquinoline and 2-methyl-8-hydroxyquinoline, as a ligand in the parenthesis of a general formula [3], and has the alkoxy group which is not permuted [a halogen atom, a permutation, or], an aryloxy group, and an alkyl group as 2 coordination and a ligand of L is made to react to an alkyl gallium, a gallium alkoxide, gallium halide, gallium nitride, an oxidation gallium, etc. under solvents, such as 1 coordination, a methanol, ethanol benzene, toluene, and a tetrahydrofuran.

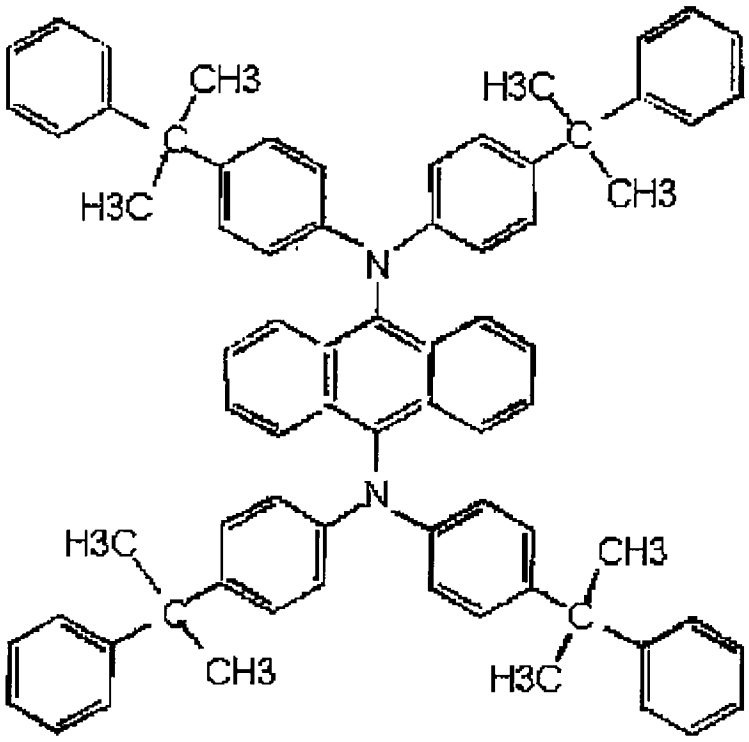
[0031] Hereafter, although this invention is explained with reference to an example, unless the summary of this invention is changed, this invention is not

limited to the following examples.

[0032] (Example 1) the organic EL device of this example -- as a luminous layer

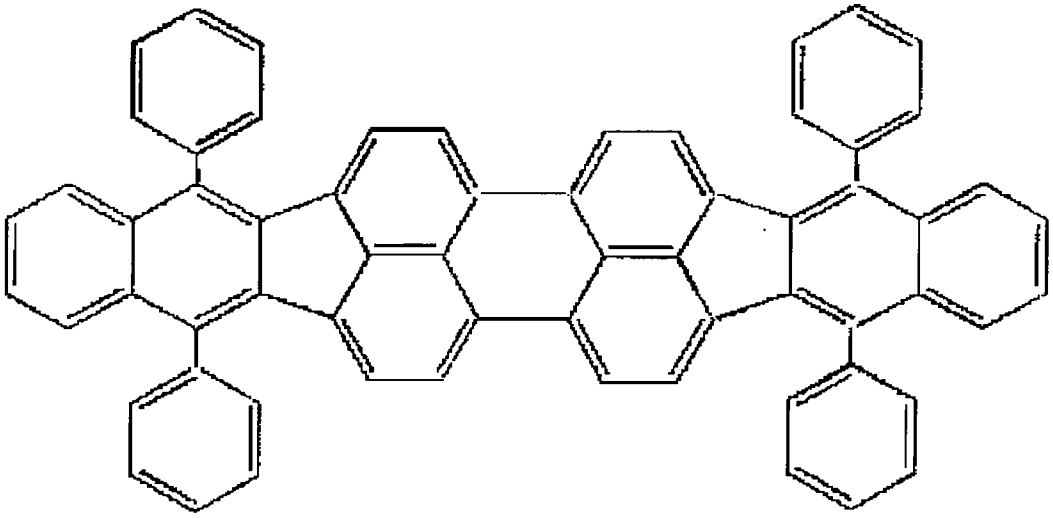
5 -- the following compound 1 -- [Formula 28]

化合物 1



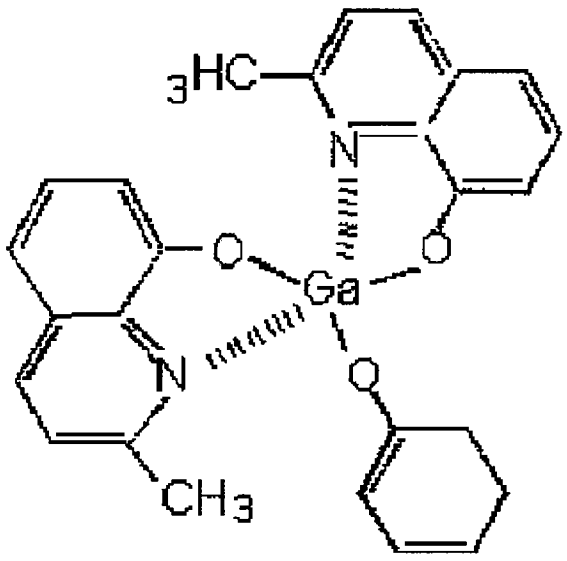
a ********** derivative -- the following compound 2 -- [Formula 29]

化合物 2



** dibenzo tetra-phenyl PERIFURANTEN was doped 2.5% by the vacuum evaporationo rate ratio. an electron transport layer 6 -- the following compound 3 -- [Formula 30]

化合物 3



It produced by forming a ** gallium metal complex. Consequently, red luminescence of the current efficiency of 6 or more (- 1,000 cd/m2) cd/A, the highest brightness of 38,000 cds/the practical use level of m2 was obtained. Moreover, this component of chromaticity stability was also good, and its change of the tint accompanying applied voltage was small.

[0033] Here shows change of the tint accompanying the applied voltage of this invention component to drawing 2 conventionally as compared with a component. The axis of abscissa in drawing shows applied voltage (V), and the axis of ordinate has shown X or the Y coordinate of a CIE chromaticity coordinate. From this, in a chromaticity X, this invention component is understood that change of a tint is suppressed, even if applied voltage increases compared with a component conventionally.

[0034] Furthermore, the life property is improving about this invention component, and the good result is obtained in the constant current drive of 5 mA/cm2. The component life property of this invention component is shown in drawing 3 . The axis of abscissa in drawing shows drive time amount (Hr), and the axis of ordinate has shown relative luminance. This shows that it is a life property to the extent that 90% or more of initial brightness is maintained, even if this invention component passes for 3,000 hours. Moreover, most dark spots (nonluminescent section) were not observed.

[0035] (Example 1 of a comparison) In JP,10-72581,A, red luminescence of maximum luminous efficiency 4 lm/W of this level and highest brightness 38,000 cd/m2 is mostly obtained with the example 1 as a luminous layer by adding red luminescent material 1% by the weight ratio to the aromatic amine derivative of said compound 1. However, the life of this component is short, it is continuation luminescence of 3 mA/cm2, and utilization is [stable luminescence is checked only for about 1,000 hours, but] difficult.

[0036] (Example 2 of a comparison) At JP,10-330295,A, when dibenzo tetra-phenyl PERIFURANTEN of said compound 2 is independently used as a luminous layer, red luminescence of brightness 1,250 cd/m2 is obtained by impression of the direct current voltage of 15V. Moreover, red luminescence of brightness 2,650 cd/m2 is obtained by impression of the direct current voltage of 15V by adding dibenzo tetra-phenyl PERIFURANTEN of said compound 2 5% by the weight ratio to 4 and 4' bis[-] [N-phenyl-N-(1"-naphthyl) amino] biphenyl. However, any example has very low brightness compared with the component of this invention, and utilization is difficult an example.

[0037] (Example 3 of a comparison) At JP,11-233261,A, red luminescence of about 52 cd/m2 is obtained by applied-voltage 9.7V as a luminous layer by adding dibenzo tetra-phenyl PERIFURANTEN of said compound 2 8% by the weight ratio to the tris (8-quinolate) aluminum of said compound 4. The

brightness after the continuation fixed current actuation of 2,700 hours in this component is decreased by 30 cd/m2. Therefore, compared with the component of this invention, brightness is very low, and since a life is also short, utilization is difficult.

[0038] (Example 4 of a comparison) In JP,10-88121,A, the metal complex shown in a general formula [3] is used as a luminous layer or an electronic injection layer. For example, when the gallium metal complex of said compound 3 is used as an electronic injection layer, bluish green color luminescence of brightness 1, 5000 cd/m2, and luminous efficiency 2.35 lm/W is obtained by direct-current-voltage 8V. however, the thing for which the metal complex shown in a general formula [3] by this invention is used as an electron transport layer of a red component -- high brightness and efficient -- long lasting and chromaticity stability are raised further.

[0039] (Example 5 of a comparison) In the patent official report No. 2828821, it is indicating to the peri non derivative and the electron transport layer at the luminous layer about the component using the tris (2-methyl-8-quinolate) gallium which is a gallium metal complex. As for this component, yellow luminescence of brightness 850 cd/m2 is checked by impression of the direct current voltage of 16V, and a luminescence life is for four days. Therefore, compared with the component of this invention, brightness is very low, and a life is also very short.

[0040] (Example 2) As an electron transport layer 6, the organic EL device was produced by the same approach as an example 1 except using the tris (8-quinolate) aluminum of said compound 4. When direct current voltage was impressed between the anode plate 2 of this organic EL device, and cathode 7, red luminescence of 5 or more (- 1,000 cd/m2) cd/A of current efficiency and highest brightness 35,000 cd/m2 was obtained.

[0041] (Example 3) As a luminous layer 5, the organic EL device was produced by the same approach as an example 1 except using the dibenzo [f, f'] Jean Dino [1, 2, 3-cd:1', 2', 3'-lm] perylene derivative of said formula [2b] for the aromatic amine derivative of said compound 1. When direct current voltage was impressed between the anode plate 2 of this organic EL device, and cathode 7, red luminescence of 5 or more (- 1,000 cd/m2) cd/A of current efficiency and highest brightness 33,000 cd/m2 was obtained.

[0042] (Example 4) The organic EL device of this example doped the compound of said formula [2b] 2.5% by the vacuum evaporationo rate ratio to the aromatic amine derivative of said compound 1 as a luminous layer 5. About the electron transport layer 6, it produced by forming the gallium metal complex of said formula [3a]. When direct current voltage was impressed between the anode plate 2 of this organic EL device, and cathode 7, red luminescence of 6.8 or more (- 1,000 cd/m2) cd/A of current efficiency and highest brightness 45,000

cd/m2 was obtained.

[0043] (Example 5) The organic EL device was produced by the same approach as an example 4 except mixing the gallium metal complex of said formula [3a] and a formula [3b], and forming membranes about an electron transport layer 6. The gallium metal complex of a formula [3a]: The mixing ratio of the gallium metal complex of a formula [3b] was set to 9:1 by the weight ratio. When direct current voltage was impressed between the anode plate 2 of this organic EL device, and cathode 7, red luminescence of 6.6 or more (- 1,000 cd/m2) cd/A of current efficiency and highest brightness 43,000 cd/m2 was obtained.

[0044] (Example 6) About the electron transport layer 6, the organic EL device was produced by the same approach as an example 4 except forming the gallium metal complex of said compound 3. When direct current voltage was impressed between the anode plate 2 of this organic EL device, and cathode 7, red luminescence of 6 or more (- 1,000 cd/m2) cd/A of current efficiency and highest brightness 38,000 cd/m2 was obtained.

[0045] (Example 7) The organic EL device of this example doped the compound of said formula [2a] 2.5% by the vacuum evaporationo rate ratio to the aromatic amine derivative of said compound 1 as a luminous layer 5. About the electron transport layer 6, it produced by forming the gallium metal complex of said formula [3a]. When direct current voltage was impressed between the anode

plate 2 of this organic EL device, and cathode 7, red luminescence of 6.5 or more (- 1,000 cd/m2) cd/A of current efficiency and highest brightness 42,000 cd/m2 was obtained.

[0046] (Example 8) The organic EL device was produced by the same approach as an example 7 except mixing the gallium metal complex of said formula [3a] and a formula [3b], and forming membranes about an electron transport layer 6. The gallium metal complex of a formula [3a]: The mixing ratio of the gallium metal complex of a formula [3b] was set to 9:1 by the weight ratio. When direct current voltage was impressed between the anode plate 2 of this organic EL device, and cathode 7, red luminescence of 6.4 or more (- 1,000 cd/m2) cd/A of current efficiency and highest brightness 41,000 cd/m2 was obtained.

[0047] (Example 9) About the electron transport layer 6, the organic EL device was produced by the same approach as an example 7 except forming the gallium metal complex of said compound 3. When direct current voltage was impressed between the anode plate 2 of this organic EL device, and cathode 7, red luminescence of 5.8 or more (- 1,000 cd/m2) cd/A of current efficiency and highest brightness 37,000 cd/m2 was obtained.

[0048] The property of the organic EL device of examples 1, 4-8 is shown in Table 1.

[Table 1]

	室温寿命 *1 (時間)	100cd/m²時効率 (cd/A)	最高輝度 (cd/m²)	85℃寿命 *1 (時間)	色度@1000cd/m²
実施例1	10000	6	38000	500	(0.62, 0.38)
実施例4	15000	6.8	45000	1900	(0.63, 0.36)
実施例5	16000	6.6	43000	2000以上	(0.63, 0.37)
実施例6	10000	6	38000	700	(0.63, 0.37)
実施例7	12000以上	6.5	42000	1600	(0.62, 0.37)
実施例8	12000以上	6.4	41000	2000以上	(0.62, 0.37)
実施例9	10000	5.8	37000	600	(0.62, 0.38)

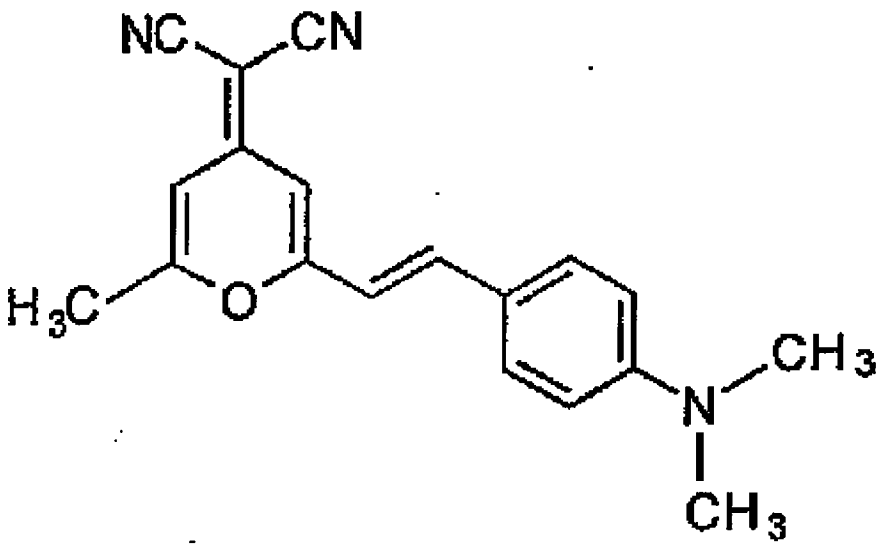
*1：初期 200cd/m²

[0049] (Example 10) The organic EL device of this example doped dibenzo tetra-phenyl PERIFURANTEN of said compound 2 2.5% by the vacuum evaporationo rate ratio to the aromatic amine derivative of said compound 1 as a luminous layer 5. About the electron transport layer 6, it produced by forming the gallium metal complex of said formula [3a].

[0050] The L-V property and J-V property of a component of an example 10 are conventionally shown in drawing 4 here as compared with a component. Conventionally, a component dopes the red dopant (DCM) of the following compound 5 to the tris (8-quinolate) aluminum of said compound 4 as a luminous layer 5, and forms the tris (8-quinolate) aluminum of said compound 4 about an electron transport layer 6. From drawing 4 , the component of an example 10 is understood that low-battery-izing is more possible than the conventional red component.

[Formula 31]

化合物 5



[0051] According to this example explained above, it sets to a luminous layer. A specific aromatic amine derivative, By mixing the specific dibenzo {[f, f']-4, 4', 7, and 7'-tetrapod phenyl} Jean Dino [1, 2, 3-cd:1', 2', 3'-lm] perylene derivative which is red luminescent material In a luminous layer, better hole transportability ability (electronic block engine performance) can be given. Consequently, the hole impregnation property to a luminous layer goes up, the recombination yield of the hole-electron in a luminous layer improves, and high brightness is obtained. Moreover, color purity also improves, without an electron escaping

from a luminous layer, since the luminous layer itself also carries out work of an electronic block layer. furthermore -- comparatively -- alike -- long lasting -- a property -- having -- triphenyl -- diamine -- a derivative -- amorphous -- an ingredient -- dibenzo one -- {-- [-- f -- f -- ' --] - four -- four -- ' -- seven -- seven -- ' - tetra--- phenyl --} -- by combining a Jean Dino [1, 2, 3-cd:1', 2', 3'-lm] perylene derivative, it is markedly alike and a life property improves.

[0052] Moreover, ionization potential of an electron transport layer can be enlarged to the ionization potential of the luminous layer of this invention by using the large organometallic complex of ionization potential as an electron transport layer. Consequently, since the hole leakage by the electron transport layer is controllable, the recombination yield of the hole-electron in a luminous layer improves further.

[0053] The aromatic amine derivative which this invention is not limited to said example and shown in a general formula [1], In the luminous layer which mixed the dibenzo {[f, f']-4, 4', 7, and 7'-tetrapod phenyl} Jean Dino [1, 2, 3-cd:1', 2', 3'-lm] perylene derivative which is the red luminescent material shown in a general formula [2] It is also possible to prepare the luminous layer from which the amount of dopes of the dibenzo {[f, f']-4, 4', 7, and 7'-tetrapod phenyl} Jean Dino [1, 2, 3-cd:1', 2', 3'-lm] perylene derivative of a general formula [2] differs more than two-layer. Moreover, it is desirable to also set the amount of dopes at

this time as 1 - 10% of within the limits.

[0054]

[Effect of the Invention] Since this invention is constituted as mentioned above and functions, compared with the former, it is excellent in luminous efficiency and can obtain a red organic EL device with good brightness and chromaticity. moreover, since a life property is also boiled markedly and improves, an organic electroluminescence display with high long-term dependability can be offered.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the outline sectional view of the organic EL device in which 1 operation gestalt of this invention is shown.

[Drawing 2] It is the graph which shows change of the tint accompanying the applied voltage of this invention component conventionally as compared with a component.

[Drawing 3] It is the graph which shows the component life property of this invention component.

[Drawing 4] It is the graph which shows the L-V property and J-V property of a

component of an example 10 conventionally as compared with a component.

[Drawing 5] It is the outline sectional view of the conventional organic EL device.

[Description of Notations]

1 Glass Substrate

2 Anode Plate

3 Hole Impregnation Layer

4 Hole Transportation Layer

5 Luminous Layer

6 Electron Transport Layer

7 Cathode